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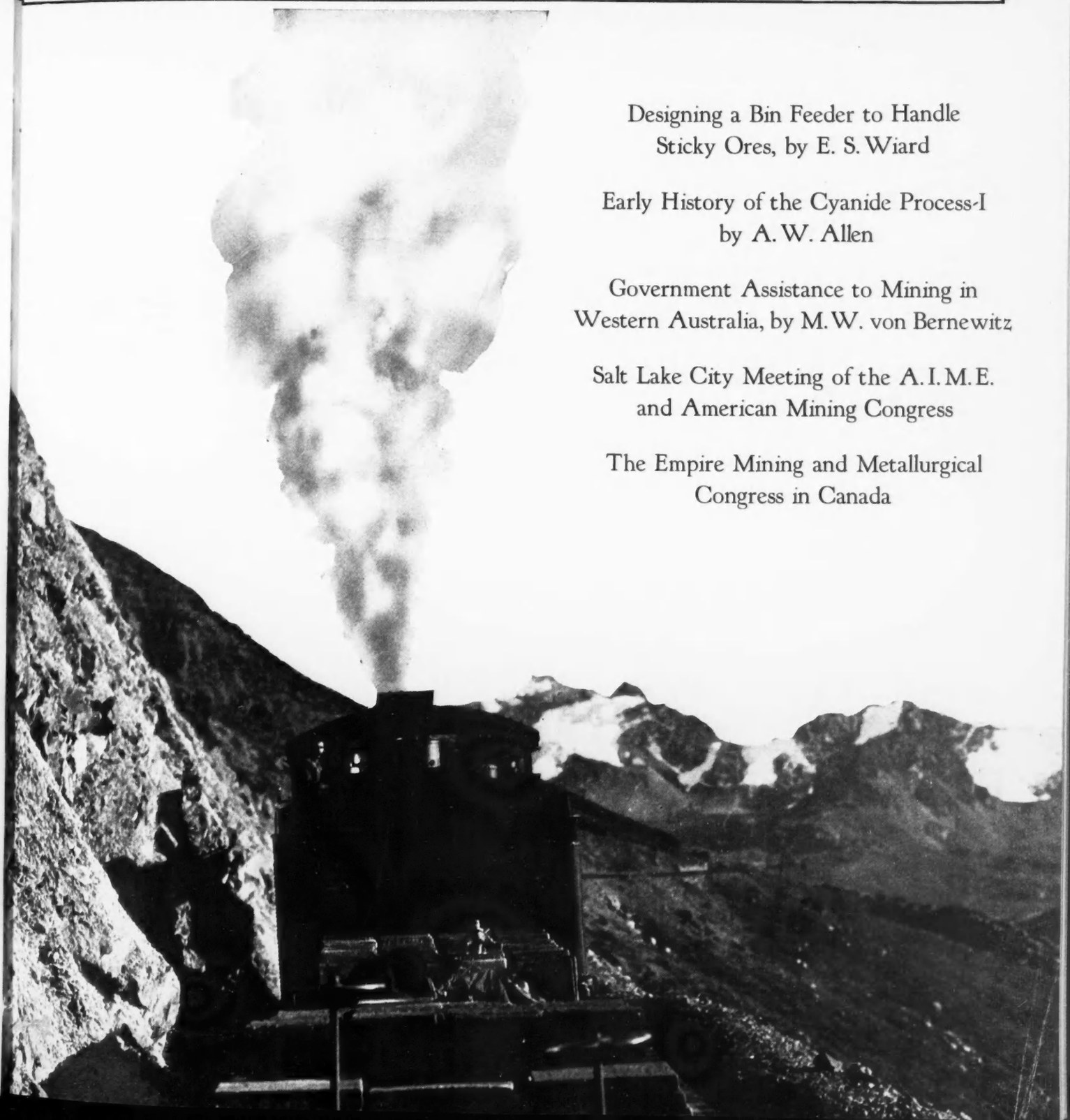


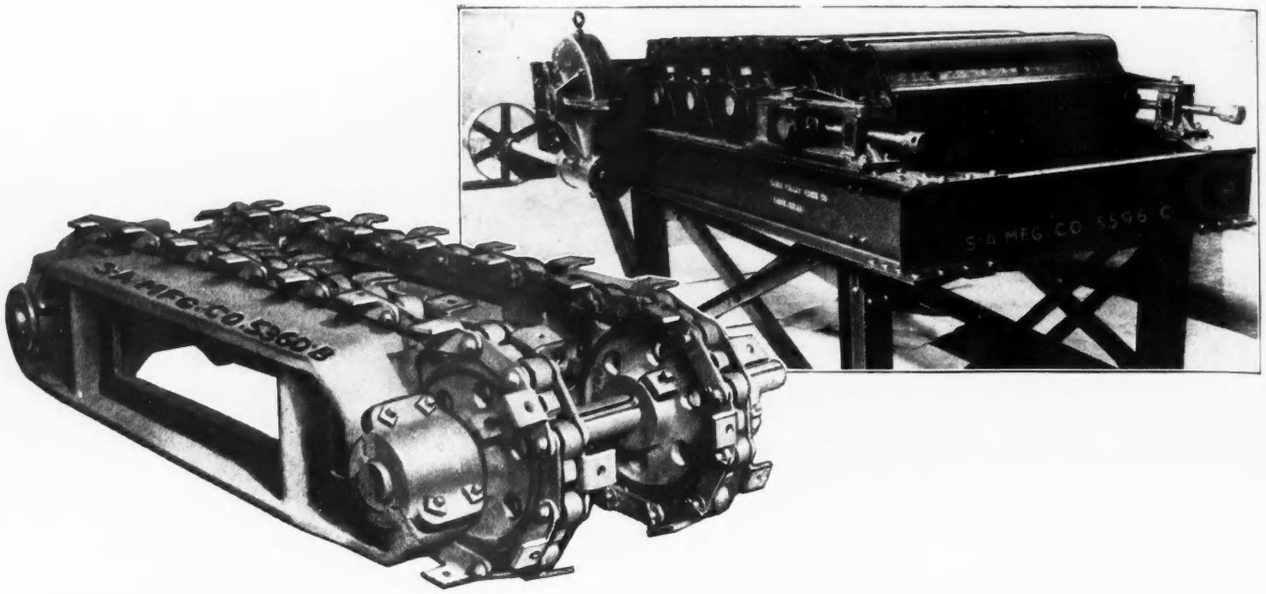
Designing a Bin Feeder to Handle Sticky Ores, by E. S. Wiard

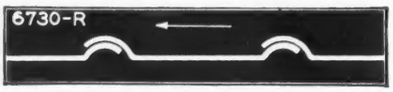
Early History of the Cyanide Process-I by A. W. Allen

Government Assistance to Mining in Western Australia, by M. W. von Bernewitz

Salt Lake City Meeting of the A. I. M. E. and American Mining Congress

The Empire Mining and Metallurgical Congress in Canada





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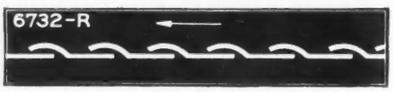

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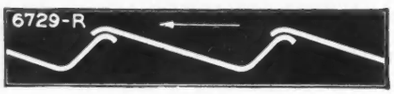

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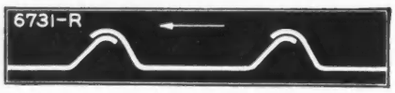

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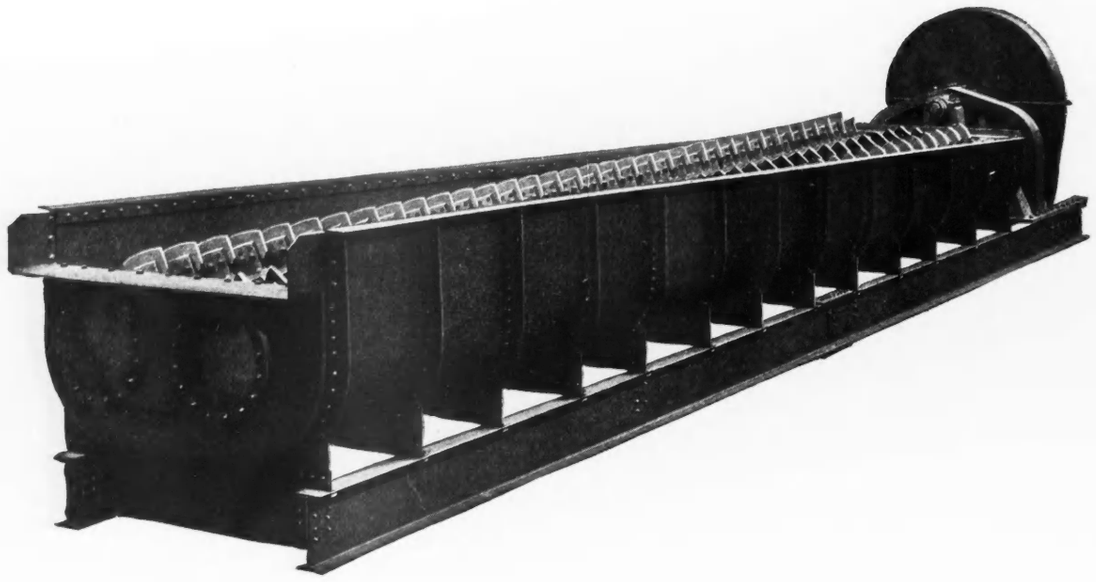

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ENGINEERING AND
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VOLUME 124 — *New York, September 3, 1927* — NUMBER 10

No Let-up in Flotation Progress

NOTABLE ADVANCES in the technology of the flotation process continue. Fifteen years ago the practice was almost unknown in the United States outside of the Butte & Superior mill, and most of the publicity concerning this method of concentrating ores came from Broken Hill, in Australia. Ten years ago the process had been fairly widely accepted in America and was even considered to have become rather highly developed, with recoveries of over 90 per cent at some mills. In fact, it was thought by many that perhaps flotation had been over-applied—that too much attention had been paid to it at the expense of research in other directions. But five years later, in 1922, flotation was being given even more attention. It was being increasingly used for concentrating other ores than copper, lead, and zinc; the Tri-State zinc-lead district was beginning to adopt it; selective separation of copper sulphides from iron sulphides, and of lead and zinc sulphides from each other, was being successfully accomplished at several plants; thio-carbanalid and ortho-toluidine were coming into use, and the advantages of cyanide, copper sulphate, and cresylic acid were beginning to be realized in certain quarters. At that time, also, some new flotation machines were appearing, though not generally accepted.

Progress in the last five years has been striking—in operative methods, in reagents, and in machines. Selective flotation has become common. Not only is it possible to make a commercial separation of two or more valuable sulphides, but barren iron sulphides can, to a large extent, be kept out of the copper, lead, or zinc concentrate, being either floated separately to make an iron ore, as in Tennessee, or rejected as waste. The introduction of xanthate in an alkaline circuit took the mining world by storm, bringing increased recoveries, cleaner concentrates, less upkeep on equipment, and easier handling of the finished product. More recently, other reagents have improved matters still further where conditions are favorable to their use. The great improvement in the results at the Utah Copper Co.'s plants is especially notable in this connection: in 1926 the average recovery of copper, using xanthate and pine oil, was 87 per cent from a 1.01 per cent ore; in the last few months, using a reagent made essentially by reconstructing high-grade cresylic acid with phosphorus penta-sulphide, a reagent devised, incidentally, by the company's own staff, the recovery has been increased to better than 90 per cent, on an ore containing only 0.97 per cent copper. To the advantage of a great improvement in metallurgical recovery may be added a lower reagent cost.

The last five years have also been productive of much improved machinery and equipment, especially of the so-called pneumatic type of flotation machine. In this matter, standardization has not yet been made, and the excellent types now available are even more numerous than a few years ago.

What will the practice of 1932 be like? We have already gone far in reducing costs and increasing metallurgical recoveries, and obviously there is a limit to both of these factors. There is still much to be done in the effort to make cleaner concentrates, and perhaps the most important advance now to be made will be in this direction. The iron concentrate may become of increasing value, and who knows but that some use, more exciting than stope filling, may be found for the tailings? The theory of the flotation process is given much less attention than it was fifteen years ago, though much of the reason for present methods and reagents is not altogether understood, progress having been made largely from empirical testing rather than as a result of fundamental research. Perhaps, five years hence, we shall know more about why certain things happen, and be able better to prescribe the proper treatment for an ore of given chemical and physical analysis. It will be interesting to observe, also, where the dividing line between flotation and leaching for semi-oxidized ores rests. Will it be feasible, by the use of sulphidizing agents or by other means, to float ores containing a good proportion of oxidized mineral, or will the tendency be, as it is at Inspiration, for example, to leach such ores without concentration?

Bandits Here and There

INTERFERENCE with American mining activities in Mexico again formed the subject of headlines in the newspapers last Saturday, this time the properties of the Amparo Mining Co. having been seized by Communists. This company has been operating for many years near Etzatlan, 40 miles west of Guadalajara, and, though carrying on its activities in a comparatively wild part of the country, has had no serious disturbance by revolutionists since the Diaz regime ended; in fact, it has been paying dividends continuously for ten years or more. Current reports indicate that many American and British families are barricaded in their homes, though apparently there have been no fatalities. The security of the company's operations has been accounted for in part by the presence of government guards during the recent troublous years, and one wonders where the guards were at the time the properties were seized.

Doubtleses by the time this is read the Mexican government will have returned the property to its owners and driven out the raiding party, but the incident again emphasizes the continued disturbed conditions in many parts of Mexico and the risk that must be taken by those who choose to live or do business in certain districts of that country. This incident comes right on the heels

of an attack on a train in which an American woman, among others, was killed by bandits' guns, and one is not likely to have to wait long before reading of other similar attacks and robberies.

The seizure of the Amparo mines will no doubt be pointed out by many agitators in the United States as a further proof of the need for American intervention in Mexican affairs. These agitators look with great concern on unfortunate happenings in Mexico, but make no comparison with outrages in the United States, where, in New York City for instance, murders average one a day. In fact, the day after the recent news came from Mexico, a civil engineer was found robbed and murdered in the streets of New York, and it seems fairly certain that one of the city's policemen, no less, did the job. Mexico is not alone among the countries of North America in being troubled with bandits, but this is not offered as an excuse for depredations south of the Rio Grande. Revolutionary activities and banditry in Mexico must be dealt with much more effectively than heretofore if the country is to attract a full measure of the capital it so badly needs.

Legislation for Pure Platinum

THE JEWELRY TRADE is to be congratulated upon the new platinum laws which go into effect in New York State and also in Illinois on Jan. 1. These acts have been sponsored by the trade as a whole and under their provisions all articles purporting to be made of platinum must bear a "quality mark" showing the amount of platinum present. An article may only be marked with the quality mark *platinum* alone, if it contains at least 950 parts in 1,000 of platinum, palladium, iridium, rhodium, ruthenium, and osmium and also provided that the metals of the platinum group, other than platinum itself, amount to no more than 50/1,000 of the contents of the entire article. The act further lays down that an article consisting of 950 parts in 1,000 of metals of the platinum group may be marked "platinum" with two provisos: more than 500/1,000 of the entire article must consist of pure platinum, and the quality mark must state, in thousandths, the proportion of platinum and other metals present thus: "600 plat. 350 pall."

Jewelers well know the benefit that has accrued to the trade by the use of the sterling standard for silver and the carat standard for gold, and by their sponsorship of pure platinum legislation they are establishing similar standards for platinum. The jewelry trade has always possessed a high standard of ethics, but because it realizes that there may be one or two dusty corners it is adopting this excellent measure for further sweeping an already conspicuously clean house. By doing so it is preventing doubtful practices such as the alloying of pure platinum with relatively large quantities of palladium, which alloy is subsequently sold to the public as "platinum"—of course at platinum prices. There has also been a practice of alloying white gold with very small amounts of platinum and capitalizing the word platinum in selling the article. The new acts make very ample provision against this practice, the marks to be used being fully set out and the proviso being made that the carat mark is to precede the platinum mark, thereby emphasizing the gold base. The trade are quite hopeful that a federal act will be passed by Congress during the coming winter. No opposition is anticipated; indeed, it was only shelved during the last session owing to pressure of business. Such an act, creating a nationally accepted standard for platinum, would be a most welcome addition to the statutes.

It is interesting to conjecture what effect the new legislative measures will have on the prices of the metals of the group. Is it not possible that there will be a smaller demand for palladium now that its use as an adulterant will be checked?

Bunker Hill and Coeur d'Alene Zinc

THE purchase recently of 325,000 shares of treasury stock in the Douglas Mining Co. at 25c. per share by the Bunker Hill & Sullivan company is interesting and significant from several angles. In the first place, it does not represent a controlling interest in the company. Usually when a big company puts any considerable sum of money into a small enterprise it wants to become the dominant figure in the management. It may be surmised that the Bunker Hill officials have faith in the mine, and, which is more important in this instance, in the honesty and competence of the management. The mine, situated in the Cœur d'Alene district, produces a so-called complex lead-zinc ore, which, until recently, it had been shipping to the Timber Butte mill, at Butte, the concentrates going thence to Anaconda's electrolytic zinc plant at Great Falls. Some months ago Timber Butte refused to accept further shipments and the Douglas mine was shut down. With its source of income shut off, certain important development work had to be discontinued. Into the breach then came the Bunker Hill, with funds necessary to continue development operations.

The transaction likewise calls attention to the fact that the new electrolytic zinc plant being erected by the Bunker Hill company in partnership with the Hecla Mining Co., at Kellogg, Idaho, will be in operation about the end of the year. At present the program calls for the production of fifty tons of high-grade zinc per day from the first unit. The primary source of ore is the Star mine, owned jointly by the two companies, but other properties will ship on a custom basis. An important consideration in the purchase of the stock of the Douglas company was the signing of a contract to purchase all of the Douglas ore for fifteen years.

A Query

WHERE is the shift boss who used to think that he could line an inclined raise without the services of engineer and transit? Formerly he was rather numerous, as more than one crooked hole in the ground might testify. At the same time, one might inquire where is the engineer who loved his Brunton dearly and used it as the shift boss used his eye, thereby at times producing a corkscrew that was of no use at all for pulling corks? Have such individuals disappeared, never to return, or is the crop perennial? The cocksureness of the old-time miner who knew it all and went by instinct is less in evidence today, perhaps because the old-time miner is passing out. Gophering is apt to spoil one's appreciation of exact and careful work.

Hydraulic Mining in California

THE Commonwealth Club of California, through its mineral resources committee, will investigate the hydraulic mining situation in California and try to ascertain the pertinent facts about the resumption of such mining in the state. The club is a disinterested organization which investigates from time to time major questions having to do with industrial progress, economics, and politics affecting the people of California. A program has been initiated through which the miners, agriculturists, and power interests will be enabled to present the views of the industries which they respectively represent and such facts as are pertinent.

An unprejudiced review of the hydraulic mining situation is greatly to be desired, for at the last session of the Legislature in California, when the small remnant of hydraulic miners made their appeal for recognition and the initiation of a definite plan for resumption of hydraulic mining, they were met by determined and prejudiced opposition from agricultural interests. The latter reflected the bitterness which has existed for many years. That conditions have changed materially and that modern methods have in themselves sufficient merit not only to permit of hydraulic mining under adequate restrictions but also to improve irrigation possibilities, were facts that were refused recognition. The farmers would not consider anything except the absolute prevention of hydraulic mining.

The attitude of the hydraulic miners has been patient. They have advanced their ideas and have discussed their plans in detail, meeting, with facts and figures, the specific objections that have appeared between the chinks of lawyers' oratory and bombast. The Commonwealth Club will do a public service of great value if it will ascertain the facts and lay them before the public for inspection.

Conservation Legislation

AN UTTERANCE meriting the careful consideration of the mining industry was made by Hubert Work, Secretary of the Interior, at the close of his address before the annual meeting of the mineral law section of the American Bar Association at Buffalo, N. Y., on Aug. 30. Secretary Work's words on this occasion were:

"A suggestion to leave with you: I believe the time has arrived when the federal government should ask Congress for legislation intended to protect our oil deposits against waste in production, and the public against future high cost of oil products. Never in our national history was the need for conserving in the ground our petroleum resources more apparent than now.

"The constituting of a committee of nine, three of its ablest members selected by the American Bar Association, three practical engineers from the oil industry, with three representatives of the government, to draft a bill for the Federal Oil Conservation Board to study and recheck, with a view to its introduction into the seventieth Congress, would seem desirable."

Much can be said for Secretary Work's suggestion, especially in view of the conditions of overproduction prevailing in the oil industry. The Secretary can hardly have in mind legislation that would put private natural resources under any semblance of government control. To do this constitutionally would probably baffle the country's ablest lawyers. Further, the adage "Less Government in business" can well be borne in mind. No, Mr. Work is doubtless thinking of legislation that will liberalize the existing anti-trust laws, so that oil companies may co-operate to eliminate the costly and wasteful competition that is now the rule in drilling for petroleum. If all the fee owners and lessees in a given area could be brought into an amicable agreement as to how the area should be drilled, the result to each would be eventually greater profits, or smaller losses. For drilling is expensive, and a mutual agreement would make it possible to get the same production from fewer wells or save the oil for a better market either by shutting in production or by deferring drilling until later. Such an agreement could not be forced upon the oil men by the government. But if the law were liberalized and the producers left alone the agreement would quickly come about.

Only after such friendly methods have been tried and proved to be failures will it be time to talk of coercive measures such as those which would result from government control.

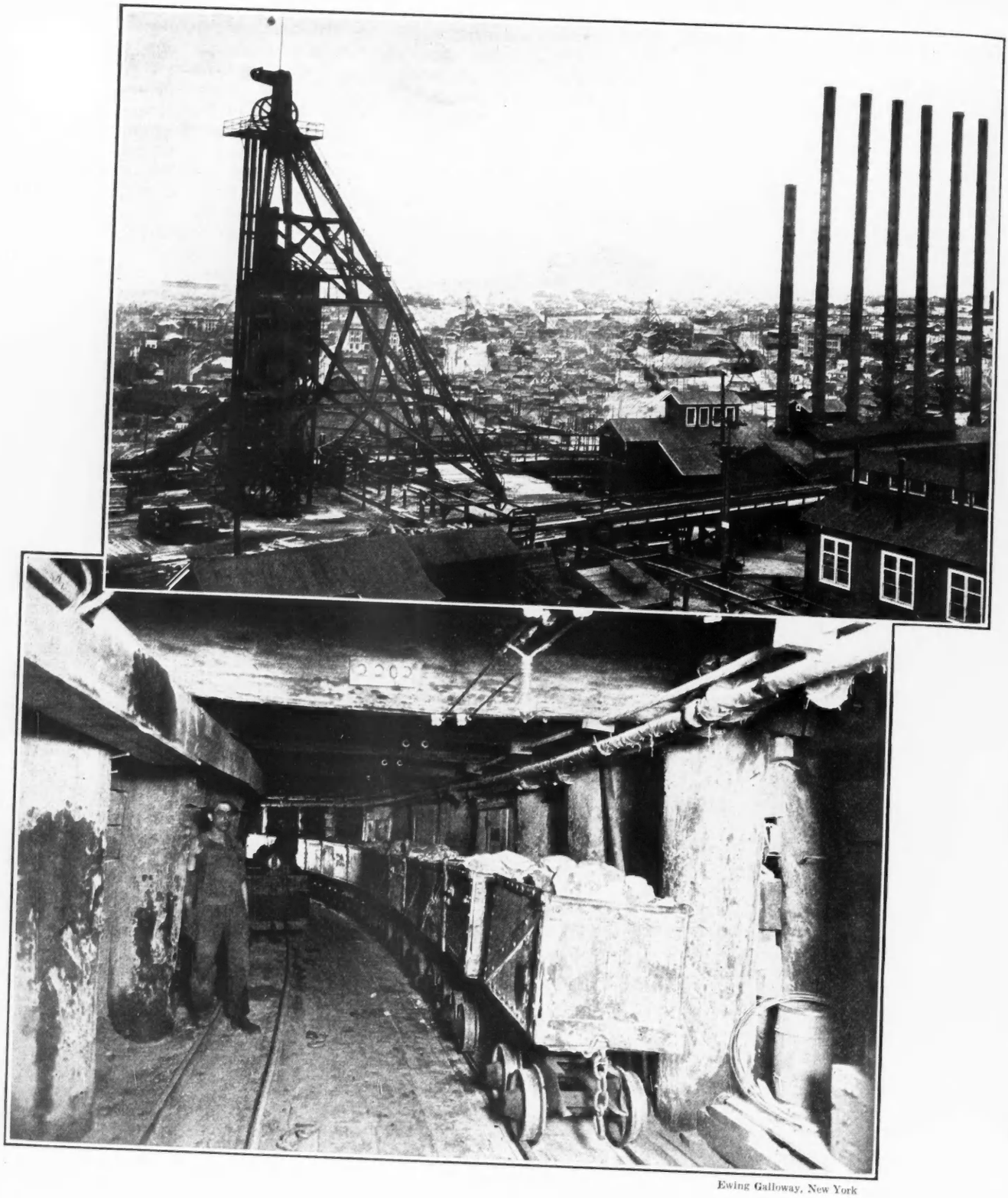
Legion, Bon Voyage!

"*FOR God and country, we associate ourselves together for the following purposes: To uphold and defend the Constitution of the United States of America; to maintain law and order; to foster and perpetuate a one hundred per cent Americanism; to preserve the memories and incidents of our association in the Great War; to inculcate a sense of individual obligation to the community, state, and nation; to combat the autocracy of both the classes and the masses; to make right the master of might; to promote peace and good will on earth; to safeguard and transmit to posterity the principles of justice, freedom, and democracy; to consecrate and sanctify our comradeship by our devotion to mutual helpfulness.*"—Preamble to the constitution of The American Legion.

Just ten years ago the vanguard of an armed force of two million was leaving American shores for France. A little more than a year later, following the accomplishment of the task with which it was charged, members of this force founded The American Legion on the principles expressed in the above preamble. With the passage of the years since its founding this organization has become a powerful influence for good within the country and one of the nation's most representative institutions.

The ninth annual convention of the Legion is to be held the latter part of this month in Paris, and during the next two weeks more than sixteen thousand of its members will embark for France. Each of these sixteen thousand may well be considered another "ambassador without portfolio," and their collective influence abroad should be as productive of international understanding as was the visit of the last so-styled representative of the United States.

The tour of the second A.E.F. is a mission of good will—good will for both the enemies and friends of ten years ago. Many mining men will be included among the departing Legionnaires—to them, and to their comrades, Bon Voyage!



Ewing Galloway, New York

Butte Above Ground and Under

The Never Sweat mine and a scene on one of its levels

Designing a Bin Feeder to Handle Sticky Ores

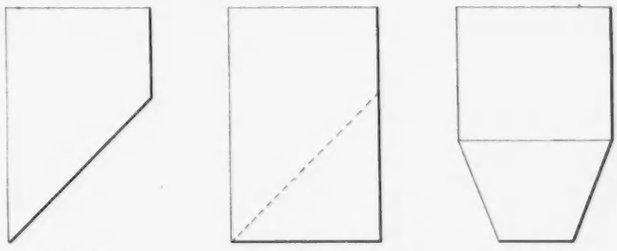
By E. S. WIARD
3200 South Acoma St., Denver, Colo.

ATTEMPTS that have been made to produce successful feeders to feed wet, clayey, sticky ores continuously and with the least aid of bin attendants are discussed in the following:

The shape of a bin affects its discharge capacity. Figs. 1, 2, and 3 represent three types of bins. As sketched, all three occupy the same cubical space. Fig. 1 illustrates in elevation a bin with square top-section and with a 45-deg. wedge or hopper at the bottom. Fig. 2 shows a cylindrical bin with a 45-deg. hopper and Fig. 3 a cylindrical bin with a 60-deg. suspended conical hopper. If it be assumed that the bins are each 30 ft. high and that No. 1 is 20x20 ft. at the top, and Nos. 2 and 3 are each 20 ft. in diameter at the top, then No. 1 will have a capacity of 8,000 cu.ft., No. 2, 6,283 cu.ft. and No. 3, 9,325 cu.ft.

Under gravity alone as a motive force the three bins will discharge with about equal degrees of freedom. A bin of the type shown in Fig. 3 will be at a disadvantage on this point, for as the ore descends the bunkered cone there is increasing tendency to jam, which is a maximum at the point of exit. The bin illustrated in Fig. 3, however, has a liberal discharge opening 8 ft. in diameter, and with the discharging means to be described the tendency of the ore to arch will be found to be an advantage. In general, however, all pieces of ore moving toward a discharge opening should do so in more or less parallel lines, as loosely as possible, and hence with as little tendency to press together and stop the flow. Bins with side discharge are ordinarily better than those with bottom discharge on this account. The internal volume of the bin is its storage capacity. Discharge capacity can be defined as that proportion of storage capacity which can be run out of the bin openings by gravity or mechanical means provided for feeding and with labor attendance just sufficient to take care of accidental happenings which stop the flow of ore. It is commonly supposed that ore will slide to bin openings until the angle of repose has been reached. This is obviously true if time is allowed.

In running off the ore of a bin that is full at the start, flow will be full and continuous for a while except for accidental occurrences, but a point will finally be reached where only by poking can the ore be made to run to the feeder or bin opening. By such use of labor the ore can be made at length to assume the angle of repose. The ore will run with increasing difficulty as the angle of rupture is reached and only with a very much greater degree of poking after the angle of rupture has been passed and the angle of repose is approached. The angle of rupture is not a fixed thing or even a fixed thing for any particular ore. For the purposes of discussing bin feeding it may be defined as slope angle of ore beyond which the ore will not slide freely without aid. In lieu of other data the angle of repose may be placed at 45 deg. and the angle of rupture at 67½ deg. With bins that are constantly receiving fresh supplies of ore from the mine the argument in favor of bins having a high discharge capacity has less weight, for in such cases in point of continuous discharge there is little to choose between bins of the type shown in Figs. 1 and 2 and that shown in Fig. 3, which with appropriate feeding devices will discharge every pound dumped into it. Nevertheless, bins of the type shown in Figs. 1 and 2 have only a part of their storage capacity available for discharge.



Figs 1, 2 and 3—Three types of ore bins

One of the indications of active movement of ore through a plant is a normally empty bin. A full storage bin has no capacity. A break in the continuity of feeding is more apt to come at the mill end of the ore flow, for it is there that the most stoppages are likely to occur.

The problem of maintaining a steady rate of movement from mine to mill and through the latter depends largely upon good mine and mill management. But good bin practice is an aid to this end. The advantages of moving the ore freely through the bin with the least labor and with maximum discharge capacity for the prismatic space occupied are far more important than the single one of more storage.

RATE OF DISCHARGE FROM BIN OPENINGS

Most authorities on ore dressing state that the discharge from a bin opening is proportional to the area of the opening. The factor of the bin being full and therefore discharging more freely under a head, to use a hydraulic analogy, or being nearly empty and therefore discharging less freely owing to a lower head, is generally disregarded. In ordinary feeding problems the difference in the rate of feeding due to the amount of

ore in the bin is scarcely discernible. With perfectly dry ore the rate of feeding increases as the ore is more finely crushed.

Gates and Feeders

The simplest kind of a bin closure is a rack-and-pinion gate. This is used for continuous feeding, as onto conveyors and into crushers, and for intermittent loading, as in filling cars. Where used for continuous feeding, the gate requires manual attendance, because ore will not flow continuously under gravity alone through a bin opening of ordinary size. Rack-and-pinion gates are most frequently used on storage bins for uncrushed ore from the mine or for coarsely crushed ore from the same source of supply. For such use the attendant sets the gate at some partly-open position and keeps it there as long as the ore will run or as long as it will run if a bar is used occasionally to loosen pieces which interfere with flow. When this practice no longer suffices to maintain the flow, it is necessary to raise the gate to the wide-open position and start an avalanche by barring at the key rocks at the bottom of the ore. When a relatively large mass of the ore is thus loosened, the gate must be closed quickly to prevent spillage. It is then again opened part way and feeding is resumed. By cycles of such operations coarse ore may be fed in a more or less continuous stream to conveyors or Blake-type crushers. Where Blake crushers are fed in this way, the lack of continuity in feeding presents no particular disadvantages. In fact, with dry ores and even with damp ores of a non-sticky character and with moderate tonnages, inasmuch as an attendant will be required to feed the crusher, the cost of labor for feeding is not a bin expense. Moreover, as is well known, crushers of the Blake type are most efficiently fed when fed intermittently. The ability to control the stream of ore is more important than a free and uniform flow. Irregular continuity, to coin an expression, is the desideratum.

In flood-feeding gyratory crushers the usual practice is to erect a bin with the lower edge about on a line with the top of the bell of the crusher. The ore is then allowed to run out of a relatively large opening into the bell of the crusher and pile up above it until it reaches its natural slope. As the crusher takes the ore away the expectation is that the pile of ore will continue to run to keep the crusher flooded. But such desired condition obtains only when there is an attendant to keep the ore moving out of the bin.

For the purpose of this article only those feeders need be considered that will handle coarsely broken ores, but as the usual types embody the same principles of action, they will be considered in general. The chief use of feeders is to regulate the rate of feeding. Feeders of the usual types outside of their immediate range have little effect in bringing the ore to the feeder, and this being the more important reason for their use in the purview of this article, it will be more particularly dwelt upon.

Feeders in general may be divided into two classes. Of the oscillating type there are two kinds—namely, shaking pan feeders and plunger feeders. These are seldom or never used on coarsely broken ore. The second class comprises continuous feeders, of which those of the pulley and conveyor types are the most common. A conveyor feeder is most usually employed to feed ore as it comes from the mine.

The mode of supplying ore to the feeder is common to all the kinds of feeders mentioned. It consists in keeping the ore undermined at the bottom of the bin over the small horizontal area above the transportative part of the mechanism by the motion of the feeder. Up to the point where the ore by gravity would feed to slopes of the angle of rupture and terminating at the borders of the mechanisms the work of ordinary type feeders is satisfactory. They perform with other functions the function of an attendant in keeping the ore loose with a bar at the bin openings so that it will flow freely.

The satisfactory action of the feeder after the rupture angle is reached will depend largely upon the coarseness of the ore. With the numerous large blocky and slabby pieces that occur in the ordinary run-of-mine ore, avalanches will be few and far apart after the rupture angle has been reached and it will be necessary to bar the ore frequently to keep it running to the feeder. With fine ore, after the rupture slope is reached, avalanches will come with sufficient frequency to keep the feeder supplied. There is little difficulty in obtaining satisfactory feeding with any kind of feeder on dry ore crushed to roll sizes or finer.

In feeding large tonnages of run-of-mine ore from long storage bins the usual practice is to have conveyor feeders at regular intervals along the length of the bin. In drawing from the bin a feeder is first set going in a full section, and when the ore ceases to run freely, the section is temporarily abandoned and feeding operations are begun in another full section. The expectation is that after the partly discharged section is abandoned it will be filled again by fresh ore supplies coming from the mine, when feeding from it can be resumed. It must be evident from what has already been stated that this mode of discharging the bins is unsatisfactory from the point of discharge and its only evident advantage is that the labor cost of feeding is reduced. Even with liberally designed bin openings and feeders to match and with full bins, chokages with the usual types of feeders are frequent.

Feeding Wet, Sticky Ores

Unless actually brought into working contact with an extra bad example of wet, sticky ores, few engineers have any conception of how serious the ore-feeding problem may be that is presented. All metallurgical engineers and millmen know that wet ore gives much trouble in dry crushing and that the discharge is more sluggish from feeders with wet ores than with dry ores. But few millmen have had contact with ores from deposits so intensely crushed and worked over by solfataric action that part of the rock structure has disappeared, with the end result that a portion of the ore is a mass of claylike material. The remainder of this article will be devoted to describing means for coping with ores of this kind so difficult to feed.

In the solution of problems of feeding wet, sticky ores, only one device has appeared that has been universally recognized as being entirely successful. This is the Challenge feeder, which is so well known and so simple in its elements that it is unnecessary to describe its details or mode of operation.

Following along similar lines of design Philip Argall designed and put into operation in the Independence mill in the Cripple Creek district a bin that was primarily intended to provide a uniform, steady feed rather than to feed sticky ores. Before entering the bin the ore, which

was dry, had been crushed to 4-in. size. In the pursuit of uniform feeding Argall divided his feeding means into two elements. The cylindrical portion of the bin, which had a 45-deg. conical bottom, too gentle a slope for sticky

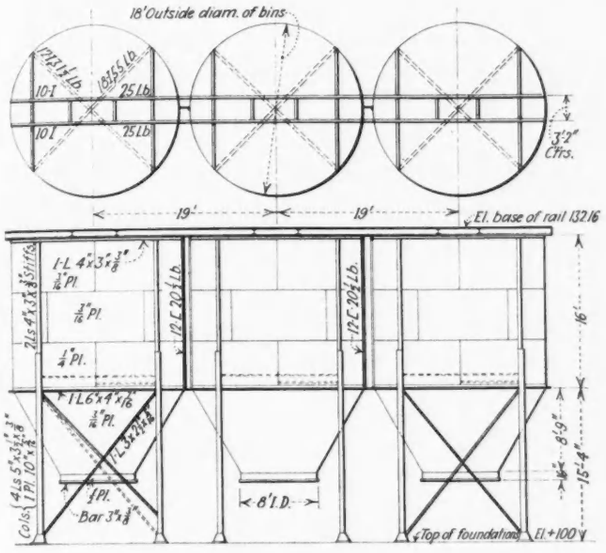


Fig. 4—Plan and elevation of ore bins at Colorado Central mill

ores, fed continuously into the small conical hopper. The ore spilled through the 4-ft. opening of the main bin and kept the hopper below filled up with ore and piled up to its natural slope above it. With the dry crushed ore supplied to the little hopper there was an actual flow head and the ore flowed out of the lower opening in a continuous stream and at a constant rate of feed so long as it was carried away by the scraper at a constant rate. A further purpose that Argall seems to have had in separating his bin into two parts was to prevent undue pressure on the pivot of the feeder disk below the small lower cone.

The scraper used by Argall would scarcely be adapted to large ore, particularly when the large pieces are mixed with sticky material. On such ore, when a vertical-edged scraper blade is used, the large pieces tend to lodge against the vertical cutting edge. This immediately increases the rate of feed, as the effect is the same as that of pushing the scraper deeper into the bed of ore on the feeder disk. Unfortunately, also, when such a piece of ore lodges in this fashion, others follow, accentuating this difficulty.

It was at the Colorado Central mill that the final step in bin disk feeding was taken in allowing the ore from the bin to spill out from the bottom bin opening directly onto the feeding disk. The mill is now a thing of the past, but one of the novel features of the plant will be described for the benefit of those who are not familiar with the feeder used. Such a radical means of feeding would not have been adopted had any of the usual types of feeders been practical.

The Colorado Central ore, particularly from the dumps, was extremely sticky when wet and never dried out completely. When wet or damp, a portion of the fines could be molded in the hand like putty. The proportion of clayey material in the ore was excessive. Much of the dump material had lain exposed to the weather for fifty years. The dump material would not run out of an ordinary-sized bin opening without constant poking. Even when the ore was kept moving with a bar under the head of a full bin, it would merely discharge to the point of forming a narrow pipe with vertical sides above the bin opening.

The Colorado Central bins are shown in plan and elevation in Fig. 4. They were designed and built by the Minneapolis Steel Co. from outline sketches furnished by myself. The bins were steel cylinders 18 ft. in diameter at the top by 16 ft. deep. Suspended from the upper portion were steel cone hoppers with 60-deg. slope edge, terminating in an 8-ft. circular bottom opening.

These bins are believed to have more discharge capacity for the cubical space occupied than any that have been built. It was possible to discharge them to the last pound of ore simply with the feeding means provided. As a safeguard against distortion of the bins while loading cross-beams were introduced at a point near the top of the main columns supporting the bin. These beams crossed one another in the center. Some distortion of these beams from falling ore was expected, but none developed.

An adjusting ring for regulating the rate of feed was suspended from the fixed thimble of the conical hopper by means of four bolts equally disposed around the circle of the bin. These bolts proved far too light. The powerful twisting action of the ore carried around on the disk tended to carry the ring around with it, bending the light bolts provided. To stop the turning of the ring a stay was carried from one of the bin posts to the ring. This stay intercepted the ring tangentially and was secured by a pin at the bin end, and the outer end was rigidly connected to a bin column. It was of sufficient length so that as the ring was raised or lowered it would spring enough to assume new positions, even though the outer end were rigidly connected. But even with this addition the upward thrust of the ore distorted the bolts. For the bolts others 1½ to 2 in. diameter should be substituted. These should be let down into

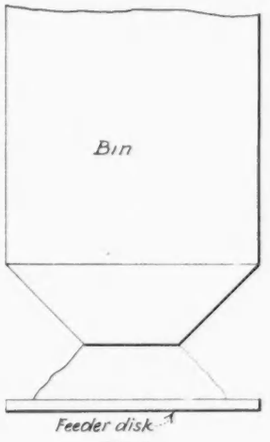


FIG. 5

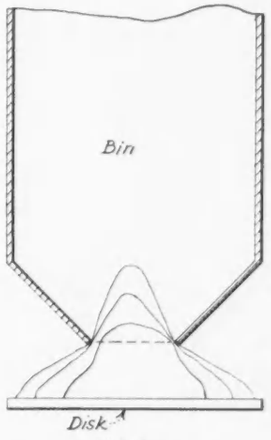


FIG. 6

Figs. 5 and 6—Diagrams illustrating how the quantity of ore rotated with feeder disk varies with the speed of the disk

deep lugs on the ring end and the other end should pass through deep lugs on the bin end.

Either a thicker ring should be provided than the one used, which was ¼ in. thick, or the one used should be

lined. Everything considered, the wear on the adjustable ring was not excessive, and being a simple element, it was easily and cheaply replaced. A heavier ring would save more frequent replacements. As the ring became thin under wear the edge tended to curl up.

The fixed thimble or ring of the bin should be lined. This was not provided for in the original design. The hopper or conical portion of the main bin was lined with heavy Oregon pine planking. This was cut in gores and closely bolted with countersunk bolts through the steel plating of the hopper. This lining served its purpose well, not having been replaced during the time that the plant operated.

The diameter of the bin hopper opening was 8 ft., that of the cast-iron feeder disk 12 ft. At the start of operations the disk was driven by a pinion on a short

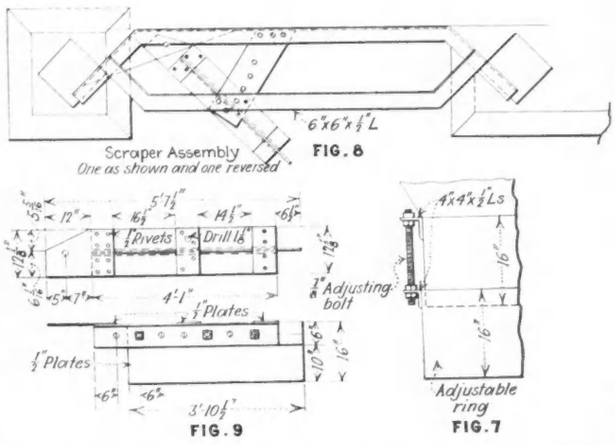


Fig. 7—Details of attaching adjustable ring to fit thimble of bin. Fig. 8—Scraper assembled. Fig. 9—Scraper plate

countershaft, which, in turn was driven by a large pulley from one of the main countershafts of the plant. This arrangement was designed to rotate the disk 1 r.p.m. At this speed, with the very sticky dump ore being handled, no stirring of the ore in the bin or any discharge from under the ring was obtained. The ore spread out little or any beyond the circle of the adjustable feed ring. Various experimental speeds of the disk were tried up to 6 r.p.m. At the latter speed the action of the feeder was so vigorous that the ore spread out in a thick layer over the whole surface of the disk and spilled from its periphery on to the mill floor. At from 3 to 5 r.p.m. the best feeding conditions were obtained. But whereas the ore at these speeds discharged without undue chokage under the adjustable feeder ring, the feeder disk was not found to be of sufficient diameter to prevent spillage. It had been hoped to find an adjustment of the adjustable ring and a rotative speed for the disk that would spread the ore out evenly on the latter and yet leave an empty margin around its periphery. Had this ideal condition been obtained, the only problem of any moment that would have remained would have been connected with the scraper and its adjustments.

How the Feeder Acts

It may be well at this point to digress a little so that the action of the feeder may be understood. In Fig. 5 the ore is shown spilled out on the feeder disk on its angle of repose, the disk being at rest. In Fig. 6 various contours are shown to illustrate diagrammatically the height to which the ore is stirred by rotation of the disk under successively increasing rates of rotation and the distance it spreads out on the disk under these rates. The highest contour represents conditions where the rate of rotation has proceeded to the point where the boundary of the stirring surface is practically coincident with the cone of rupture. The rate of rotation to produce this height of stirring will ordinarily be from 3 to 5 r.p.m. A higher rate of rotation causes a rattling around of the ore in the bin and an undue amount of wear and tear and vibration. There is very little movement within the cones of ore carried around in the center of the feeder disk except at the higher rates of speed. The contours represent the surface where the more or less fixed cone of ore revolving on the feeder disk separates from the moving down stand of ore in the bin. The cones of ore stir the ore in the bin and it slides down and out in the annular space between the cones of ore and the adjustable ring, and out onto the face of the feeder disk.

The action of this type of feeder will now be seen to be different from that of the Challenge feeder. In this device the ore falls out of the hopper opening and is carried around by the feeder disk to the scraper, where it is forced off the disk.

A Precaution Against Packing

The Colorado Central dump ore after a heavy wet snowstorm, if allowed to stand without feeding in the bin for a few days, would pack in so solidly that it could not be fed even with the extraordinary means provided. On this account, if it were to be done over again, I would be inclined to provide bolted or removable sections or even hinged doors not only in the cone hopper but at points on the cylindrical portion of the bin.

When it was seen that under the proper rate of rotation of the feeder disk to secure good discharging conditions the ore tended to spill over the periphery of the feeder disk, the latter was extended a foot all around, so as to increase the diameter to 14 ft., by a floor of heavy planking resting on sills made of studding. The studding was bolted through the feeder disk. The disk was also inclosed by a fixed pen, which was supported as follows: Rails were bent in the shape of wide U's. One leg of the U was short and was riveted to the bin columns. The longer leg the face of which was almost in contact with the feeder disk was embedded in the concrete floor below it. The pen, which was made of light sheet steel about 18 in. deep and open only at the point where the scraper was introduced and the ore discharged, was riveted at the proper height to the flat side of the long legs of the U.

Before the planking was installed the disk was worn appreciably in a circle directly under the circle of the adjustable ring. After the planking was installed wear occurred in the same place. The planking as installed was carried across the face of the disk in parallel lines without any attempt to cope with the problem of extra wear under the adjustable ring. It would have been better to make that part of the disk clothing directly under the adjustable ring removable and replaceable without disturbing the rest of it.

Wear on the disk face comes about from temporary lodgment of large pieces of ore caught between the

adjustable ring and the feeder disk. At such times, since the piece of ore is stationary, though the disk rotates, wear must follow.

A protective coating of ore might be maintained by fastening to the deck of the disk angle irons with their points up, disposed in radial lines. If there were plenty of old belting available, I would be inclined to tack this securely to the disk deck to a thickness of two or three plies. The wear on the deck was not excessive, however, and a new deck would not require any repairs over a period of two or three months.

The scraper used is shown in Figs. 8 and 9. One fault of the design of this element has already been touched upon: The straight-edged and straight-sided scraper placed too directly athwart the direction of movement of ore on the feeder disk causes ore jams. If the ore must be led away from the feeder disk in a radial direction, as was required for the feeder disks of the Colorado Central rock house, then to reduce the arc of the disk involved in discharge to the smallest limit it is necessary to thrust the scraper into the bed of ore on the disk at an obtuse angle to the lines of motion of the ore particles or else to provide a curved scraper to turn the ore sharply off the feeder disk. The front edge of the curved scraper should be curved as is the front edge of a land plow. In fact, the general proportioning of a land plow can be very nearly applied to a curved bin scraper. The curved inner face of the scraper should be sloped like the mold board of a plow, but not to so great a degree. With a land plow all the dimensioning is to the end of throwing the soil up and out with the least tractive effort. With the scraper the aim should be to prevent packing by providing means to loosen it by raising it as it is turned toward the periphery of the disk. A sloping face to the scraper will assist in doing this.

The scraper should have two handwheel controls, one for forcing it into the moving bed of ore on the disk and for withdrawing it in regulating the rate of feed. As a part of this element there would further have to be a threaded rod on which the handwheel would be rotated to advance and recede it; two fixed lugs between which it would be seated and through which the rod would pass freely, the forward end of it being secured to the scraper, and finally a slide or guide for the scraper. The second handwheel would actuate a mechanism for swinging the elements just described through a small angle so that after the scraper had been run in or out to any desired position the cutting or ore-driving edge could be adjusted to point into the ore with the least opposition to its movement.

Improving the Rotating Disk

The rotating disk, which is shown in Fig. 10, can be greatly improved in detail if the expense of doing this is not the determining consideration. The pedestal should preferably be made in two pieces with detachable vertical wearing shells so that it would be possible to remove the pivot without raising the feeder disk. Some difficulty was experienced at the start of operations with the pivots sticking in their seats. This arose from dirt getting in the pivot bearings before they were put into operation. To get at the pivots after these mishaps required the complete disassembling of the feeders. The ability to disassemble the pivot base would be valuable for an occasional cleaning and inspection and for repacking with fresh grease. A central ball race with loosely fitting centering pin would be better mechanical arrangement than the plain pivot. A separate motor drive with interchangeable trains of gearing for changing the rate of rotation of the disk would be better than the shaft drive when the feeder feeds directly into a crusher. With such an arrangement there should be a stopping switch within easy reach of the crusher man at his station at the crusher.

In estimating the power required to drive the feeder the weight of the disk and accessories and the ore spread upon it was used to compute the pressure on the pivot. The extra weight of ore above the adjustable ring comprising a cone the slope angle of which is equal to the angle of rupture was also added in computing the pivot pressure. From the total bearing pressure on the pivot the horsepower required to drive was computed from the rules for determining this figure. Liberal allowances

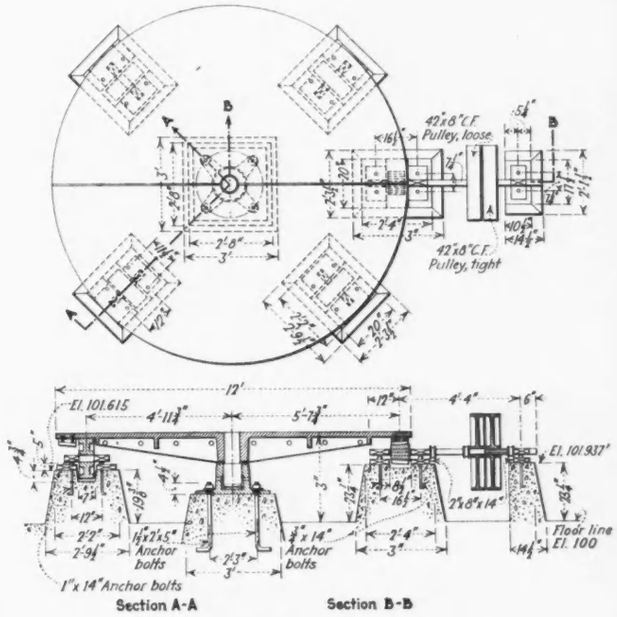


Fig. 10—Detail of table feeder

were made for sources of friction that were not computable and it was estimated that 5 hp. was needed to drive a single disk. In practice it was found to be about 6 hp., the difference being due to the higher rate of rotation than was originally contemplated.

Development of Mines in Morocco

CONSIDERABLE prospecting activity is noticeable in Morocco, as is indicated by the fact that not fewer than sixty to seventy prospecting permits have been issued monthly during the last few months by the Mining Department of the local administration, which is, of course, French. Most of the work is being carried out in the Atlas Mountains. Furthermore, the department has recently granted fifteen exploitation licenses, whereas at the beginning of the year only four were held.

Although these facts are in themselves no criterion of the richness of Morocco, they nevertheless indicate that the mineral possibilities of the area are sufficient to attract the interest and attention of prospectors and investors. Until the completion of the Casablanca-Marakesh Railway, the mines will be badly handicapped by the distance from the coast. Fortunately, this line should be finished within a year.

Government Assistance to Mining in Western Australia

By M. W. Von Bernewitz

THE *Mining and Scientific Press* for May 23, 1908, contained a short article by me on the water supply for Kalgoorlie, Western Australia. The system, the main conduit of which is 351 miles long, had then been in operation six years and the remark was made that the benefits to the mining industry, railroad, and community, were almost incalculable. The system has indeed continued to be an asset of immense value to the district for the last twenty years, during which period the mines have yielded gold to the value of $231,000,000.

Water Supply Still Available

When the water first arrived at Kalgoorlie, in 1902, the mines were at their best and were producing gold to the value of $23,000,000 yearly from rich ore and paying big dividends; now the mines are at their lowest ebb and produce only $6,500,000 worth a year from much less of low-grade ore; profits are meager. Yet the water —and it is good water—is available in ample quantity, but for twenty-six years the Goldfields Water Supply, as it is officially known, has not been profitable. That is to say, the income has more than paid operating expenses every year, but the maintenance, interest, and sinking fund have absorbed the balance, and more, and thus left an annual deficit. The sinking fund for the redemption of the total capital expenditure of $17,500,000 has been an admirable feature of the financing of this project; each year a large sum has been put aside for this purpose, until now it amounts to $14,900,000, being thus only $2,600,000 short of the amount required to pay off the original loans.

The following tabulated description of the project may well be given:

Sponsor for project and year	Sir John Forrest in 1895
Engineer-in-chief	C. Y. O'Connor
Reservoir completed (capacity 4,650,000 gal.)	1901
Main conduit (351 miles of 30-in. pipe), eight pumping stations, and twenty-two receiving and service tanks and reservoirs completed	1902
Total net lift (foot of main reservoir to Kalgoorlie), ft.	1,210
Daily capacity of plant and conduit, gal.	5,000,000
Type of pump and maker	Triple-expansion, high-duty Worthington pumping engines by James Simpson & Co., England, and the Worthington Machinery Co., United States
Cost of pumping 1,000 gal. 100 ft. high, cents	0.88
Makers of main conduit	Imported ¼- and $\frac{5}{16}$-in. steel plate curved and jointed by Australian patent by Mephan-Ferguson Engineering Co., and Hoskins Brothers, Australian firms
Total water area supplied, square miles	16,000
Pipelines, miles:	
Main	351
Gold fields towns and districts	226
Agricultural towns and districts	877
Total	1,454
Daily average consumption in 1925-26, gal.	4,145,000

Soon after the project had been put in operation it was realized that the gold fields (including, in addition to Kalgoorlie, a number of small districts adjacent to the main ore supply) would not require the full capacity; for this reason pipes were laid into the agricultural districts relatively near the main reservoir, and also to the metropolitan area of Perth, capital of the province, which is 12 miles distant. In a year the gold mines consume 433 million gallons, compared with 153 million by farms and towns, 294 million by Perth, and 85 million by the railways.

The 351 miles of main conduit was originally laid in a trench and covered, but soon after it was found that pitting and nodules were forming on the inside and corrosion was taking place on the outside, in spite of the fact that the pipes had been dipped in hot asphalt. Lime was then added to the water (3 to 5 grains per gallon) at No. 2 pumping station, which is 1½ miles from No. 1 and 421 ft. above it. This treatment inhibited corrosion to some extent. Later, a lime-settling tank was installed at the reservoir, and in 1917 a de-aërating plant to remove dissolved air from the water was erected at No. 1 pumping station, just below the reservoir. The salinity of the water in July, 1926, was thirty-two grains per gallon. From 1904, when there were two holes in the main conduit caused by corrosion, the number has increased to a maximum of 9,704 holes in 1923. Each year several miles of main is uncovered, examined, and given the attention needed, and now 118 miles are in open trenches. Fourteen miles of main have been replaced by new pipe and 19 miles have been relaid with renovated pipe. This corrosion and replacement has been largely responsible for the financial deficit each year, as the annual maintenance cost now exceeds $200,000.

This water supply has been of almost incalculable benefit to the gold fields, and no local supply could have sufficed—at least for Kalgoorlie, where condensed and dense salt water were formerly used, which was used for all purposes—operations and domestic. The revenue from the agricultural districts and Perth has helped the finances considerably, but maintenance of the main, which undergoes an excessive amount of corrosion, has more than offset the revenue from agricultural services. No private company would have operated so many years at a loss. Such a corporation would probably have raised the price of the water (which was reduced a few years ago) or, possibly, sold out to the government. Other distant small gold fields are supplied with water from wells and tanks which have cost the state government nearly a million dollars.

These notes are compiled from the report of the Department of Public Works and Labor of Western Australia for the financial year 1925-26.

Custom Mills

Another form of government assistance to mining is the State Batteries, as they are officially termed, operated by the Department of Mines, whose report for 1925 gives the notes following: There were six 10-stamp mills and twelve 5-stamp mills operated last year, and nine 5-stamp mills were leased. There are also 13 cyanidation plants. These mills crushed 17,825 tons of gold ore and 268 tons of tin ore, about the same as in 1924-25. Amalgamation recovered 75 per cent of the gold. Of the gold in 14,289 tons cyanided, assays called for 80 per cent extraction, but the actual extraction was 80.7 per cent.

From their date of inception these State Batteries, to March 31, 1927, have milled 1,441,160 tons of gold ore and 80,728 tons of tin ore, yielding a total of $28,600,000. The total cost of the custom mills and cyanide plants was $1,930,000, and since their inception there has been an operating deficit of $682,000 apart from interest charges on capital outlay.

During 1925 the Department of Mines advanced $27,000 for providing means of transport and equipment to prospectors.

Early History of the Cyanide Process

Story of the Pioneer Investigators and the Patent Situation—Influence on World Economics

By A. W. ALLEN
Chemical and Metallurgical Engineer, Berkeley, Calif.

A. W. ALLEN

HISTORICAL surveys are of particular interest in permitting a group presentation of happenings and developments that occurred at some earlier date and in connection with a phase of progress that failed to "take" in some parts of the world, "marked time" in other parts, and spread like wildfire elsewhere. Such were the beginnings of the cyanide process, to be described in the present article and in succeeding installments—a story that gives in brief compass the variations of reaction to innovation, and proves the importance of the personal element and the aggressive business organization in forcing the acceptance of a technical improvement of even the most momentous economic significance.

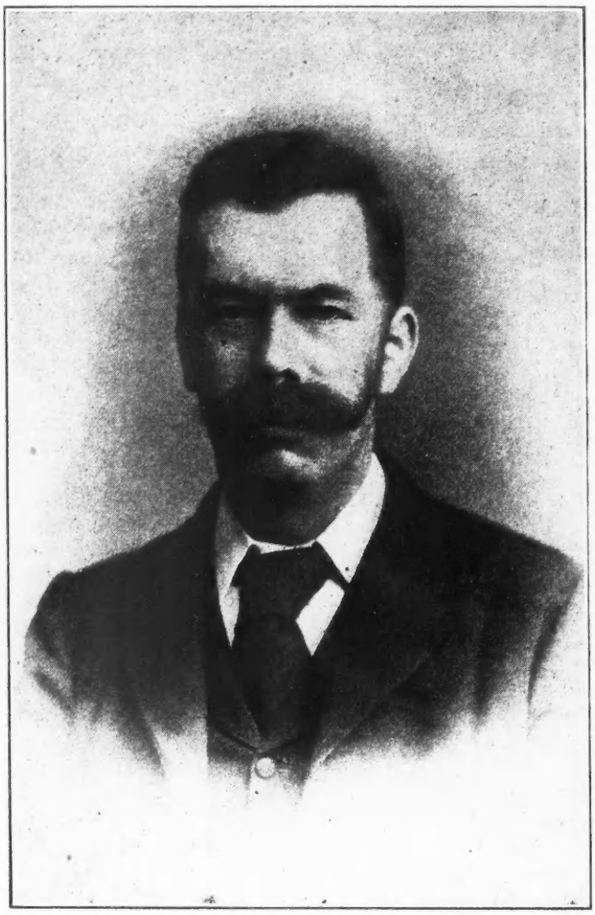
The direct results of the introduction of the cyanide process are easily appreciated, and computable with almost mathematical accuracy. The indirect effects, however, have been of far greater importance. The intensive struggle for efficient result during the early years of the operation of the process initiated a new era in metallurgical engineering and technical advance. By sane co-operation and by the stimulus of keen professional competition among several groups of enthusiastic technicians, the art of cyaniding advanced and the technique of leaching and filtration so improved that, a few years later, to quote an average representing millions of tons of ore treated per year, a raw material entering a cyanide plant and containing less than 1/1,000 of 1 per cent of gold could be impoverished so cheaply that satisfactory dividends could be paid to stockholders, the loss of gold from the plant amounting to less than one-half of 1/10,000 of 1 per cent, or about 0.00005 per cent. When one takes into consideration the unstable character of the solvent used, the absorbability of the earthy material present in the ore, and the necessity for the efficient displacement of a solution of gold of extremely low metal content, it will be realized that the successful development of the cyanide process gave new life to the chemical and metallurgical industries.

In the first place, the widest technical publicity was encouraged on nearly all the more progressive gold fields where the MacArthur-Forrest invention was applied. The non-ferrous mining and metallurgical magazines of the world, from 1900 to 1910 in particular, were kept alive by the continued progress and success of the process. Slipshod technical accounting, or none at all, was discouraged in the larger communities. Operations were tuned to a high pitch of efficiency, and only by adequate technical control was it found that flaws in beneficiation could be detected and performance of standard excellence insured. Routine testing schemes were developed and perfected, thanks to the personal initiative of willing and enthusiastic chemists and cyanide engineers. The automatic weighing and sampling of ore, of intermediate and final products, were perfected and simplified so that ignorance of metallurgical results could no longer be claimed as an excuse for inferior performance. A thousand and one improvements were introduced, in as many plants, as minor details. The stamp mill was increased in size and weight and capacity, to be displaced to a large extent by more efficient secondary crushing apparatus. The tube mill was borrowed from the cement industry, and made the object of exhaustive scientific investigations to determine desirable diameter, crushing-media and ore-feed load, and correct speed for maximum production. Simultaneously, all over the world, inventive operators developed improved types of cylindrical-mill lining, scoop feeders, and discharge arrangements. Substitution of domestic stones as grinding media in place of imported flints effected immense economies in practical operation.

The rapid acceptance of the tube mill as a fine or intermediate grinder prior to cyaniding was the main stimulus that led to the invention of mechanical classifiers, and to the improvements that were made to the hydraulic classifiers at that time in accepted use. The tendency to carry comminution to greater and still greater degrees, as the ores passed from the oxide to the sulphide zones, necessitated immediate attention to the problem of separating a clear overflow from a stationary or flowing slimed-ore pulp. Invention of various types of intermittent and continuous thickeners followed in a sequence that had become an accepted one. The mathematics of decantation was studied, and theory successfully applied to practice. Continuous countercurrent decantation was then perfected.

As each problem was solved, and as each new machine could be left to itself, as it were, the cyanide engineer looked further ahead. The old type of plate-and-frame

filter press was improved and adapted as a self-discharging unit, whereby its most serious drawback—the expense of opening, cleaning, and closing—was obviated. Then in quick succession came the invention of the various rotary vacuum filters, the basket-type vacuum filters, and the inclosed-type filter presses. Simultaneously, improvement after improvement was reported in the design and performance of pressure pumps handling sand and slime pulp and in conveying equipment generally. Large tonnages of crushed ore were moved and distributed at small expense. The filling of leaching vats by belt conveyors and the mechanical discharging of the residues were details introduced early in the application of the cyanide process. To eliminate the complexity of the peripheral-discharge ball mill, with step liners, and the cost of its operation, various alternatives of much simpler design were perfected for wet crushing. In the complex-ore field, the cyanide engineers successfully turned their attention to improvements in roasting practice and in the development of efficient grinding and amalgamating pans. Few of the major developments that occurred in the early days of the cyanide process have not since been adopted and utilized in other technical industries. This is particularly true in the comparatively recent and extensive field of the processing of raw, prepared, or manufactured material, in which the basic technique in automatic delivery and discharge, in dissolving, grinding, leaching, clarifying, counter-current decanting, thickening, filtering, and technical control, are, each and all, reminiscent of the intensive and fascinating developments that marked progress in early cyanide days. Chemical engineering today owes much to the initiative and keenness of the pioneer cyanide engineers. The early history of the cyanide process is therefore of economic as well as of technical significance. It is hoped that the following account, although necessarily condensed to meet the exigencies of space, will prove of interest. The author, whose professional work abroad has taken him to most of the major fields of cyaniding operations, and has at various times brought him into personal contact with the early pioneers and workers, has made every effort to keep the account in balance. But excuse may well be offered in advance for an omission, an occasional lapse from accuracy, or a misinterpretation in so wide a survey. It is intended to republish the history in booklet form, after revision. Readers who have suggestions to make or corrections to offer are invited to communicate with the author by letter, to be sent care of the Editor of *Engineering and Mining Journal*.



JOHN STEWART MACARTHUR—1857-1920

The cyanide process of extracting gold and silver from ore and recovering the metals in the form of bullion is to be credited to the initiative and research of J. S. MacArthur, a chemist, and R. W. Forrest and W. Forrest, physicians. The experimentation that culminated in the fundamental discovery was made in Glasgow, Scotland, in 1886; it began in a small laboratory arranged under the consulting rooms of the two physicians, most of the work being done between 8 p.m. and 2 a.m. In all the tests, however, success was gaged by a consideration as to whether or not actual gold could be produced by the combination of methods adopted, and a neglect to appraise the value of theoretical research resulted in faulty deduction and delay. Various solvents, of a dilution indicating commercial practicability, were tried; and sulphuretted hydrogen was used as the precipitant. With a weak solution of potassium cyanide there was no result—no gold was precipitated; and the experiment was voted a failure. As a matter of fact, however, the first stage of the new process had been successful. But practical commercial results were being sought, as they invariably are in industrial research, and a scientific fact of importance passed unnoticed and unrecorded. Nearly a year later a reconsideration of results led to an analysis that indicated the absence of gold in the residue from the original experiment, and it was then realized that the failure to recover the metal in the first instance was because the precipitant was ineffective. Further tests confirmed the conclusion that the gold had been readily dissolved by means of a dilute solution—a feasible step from the commercial standpoint. The suggested use of shavings, cut from sheet zinc, for precipitation purposes, formed the essentially novel and complementary feature of the discovery.

Significant advances in the development of the cyanide process followed its first commercial application in New Zealand in 1889, where it was introduced by J. McConnell. J. S. MacArthur and C. J. Ellis were responsible for the suggested use of lead salts, in the early nineties. Further progress was due to H. L. Sulman and F. L. Teed, for the use of bromocyanide in the treatment of refractory ores, and the use of zinc dust, in 1894; to G. Moore, on the fundamental idea underlying the mov-

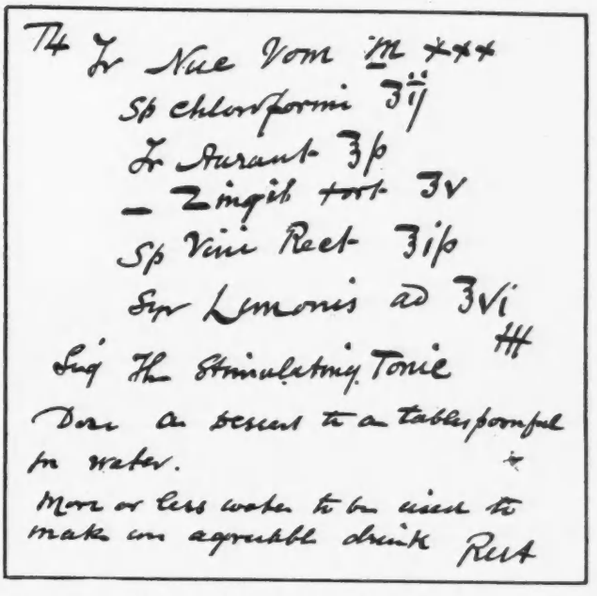
able type of vacuum filter, patented in 1902; to W. A. Caldecott and F. C. Brown, on the introduction and application of the air lift in slime agitation, in 1898 and 1903, respectively, Brown being associated with S. D. McMiken in this work; H. R. Cassell, for the first stationary type of leaf vacuum filter, developed at Cripple Creek, Colo., in 1904; to E. L. Oliver, for the invention in California of the first successful continuous vacuum filter, and to J. V. N. Dorr, for the development of an automatic and continuous thickener, both in 1906.

Succeeding Developments

The success of cyaniding on a large scale was to a considerable extent due to the energy of Alfred James, whose aggressive action in South Africa forced attention to the opportunities offered, and who was responsible for the design, in 1890, of an extractor box for zinc shavings, since adopted universally. Credit is also due to W. A. Caldecott and others in South Africa for the frank publication of the results of early research and for constructive work based on a scientific appreciation of the details of operation that served to elevate the process to a high plane of technical endeavor; to C. J. Ellis, for the demonstration of the feasibility of decantation treatment, in 1893; to Hennen Jennings, R. Mein, and F. Irvine, for the introduction of direct filling into leaching vats—the most important mechanical development subsequent to the rehandling of dumped tailing; to Philip Argall, who introduced the roasting of sulphotelluride ore, at Florence, Colo., in 1895; to D. C. Jackling, who in 1896 developed the process, and designed and operated the first successful large plant, in which the roasting of complex arseno-pyritic ore was practiced, at the De Lamar-Mercur mine in Utah, being also the pioneer in the use of zinc dust in the United States; to J. R. Williams, for the first practical system of decantation, evolved on the Witwatersrand gold field, in 1896; to J. W. Sutherland, who first adapted on a large scale, in 1897, the plate-and-frame press for the treatment of gold ore at the Hannans-Brownhill mill at Kalgoorlie, Western Australia; to C. W. Merrill, who perfected the use of zinc dust as a precipitant in 1897, being responsible also for the invention of the self-sluicing filter press that solved the problem of slime treatment at the Homestake; to Ludwig H. Diehl, the "father" of large-scale all-slime treatment, who introduced the tube mill in the metallurgy of gold, at the Hannans Star mill, Kalgoorlie, in 1898; to Charles Butters and his technical associates, for the successful development of the fixed type of vacuum filter, and for many other valuable contributions to the art of cyaniding; to Dr. C. J. Martin, who at the instigation of the Victoria (Australia) government, carried out researches that in 1902 demonstrated the value of the ferric hydrate method of combating cyanide poisoning. The work of S. F. Kirkpatrick in the use of aluminum dust as a precipitant and of K. B. Moore and H. R. Edmands in the efficient utilization of charcoal for the same purpose are worthy of mention. P. S. Tavener was the originator of the highly efficient smelting method associated with his name, first introduced at the plant of Bonanza, Ltd., Transvaal, in 1899.

Meager Contributions From Academic Sources

The success of the cyanide process, from the chemical standpoint, has been due to a great extent to the initiative and enthusiasm of private engineers; and much that has profited the mining industry, permitting cheaper beneficiation and the more scientific control of operations, has resulted from unpaid effort. Contributions from academic sources have been meager, the outstanding exception being the researches of the late Prof. S. B. Christy, of the University of California, with particular reference to electrochemical phenomena. To J. E. Clennell especial credit is due for the compilation of that exceptionally useful treatise—"Chemistry of Cyanide Solutions." Control work has been simplified as a result of the initial suggestion of W. R. Feldtmann and the subsequent researches of G. A. Goyder and W. Bettel, which led to the development of a reliable method for the determination of total cyanide in working solutions. A satisfactory routine test for the estimation of protective alkali was devised by L. M. Greene. B. Bay carried out pioneer research on the character of the so-called white precipitate, and other chemists who have contrib-


℞ Ir Nuc Vom M ***
Sp chlorformi 3ij
Ir Aurant 3p
– Zingib tinct 3v
Sp Vini Rect 3ip
Sir Limonis ad 3vi
Sig The Stimulating Tonic
Dose a dessert to a tablespoonful in water.
More or less water to be used to make an agreeable drink
Rect

The prescription of Dr. R. W. Forrest, one of the co-inventors of the cyanide process, for a tonic used to prevent sleep during the early experimental work at night in Glasgow, Scotland

uted materially to the systematizing of the process include A. F. Crosse, E. M. Hamilton, W. J. Sharwood, W. K. Betty, W. H. Virgoe, and J. Moir. A. Chiddey developed a method for the assay of cyanide solution containing gold and silver, which found wide application and has persisted as standard practice.

Economic Effect

The economic effect of the introduction of the cyanide process was significant. During the year when the first patent was granted to MacArthur and his associates (1887), the total world production of gold was valued at about $110,000,000. In 1897, ten years later, it was valued at about $237,000,000. Much of the increase was due directly to the introduction of cyaniding. In addition, a wide field for the treatment of low-grade ores was opened up by utilizing the standard method of amalgamation with mercury, followed by cheap leaching with cyanide solutions. The increased world output of gold was halted in 1899 because of the outbreak of war in the Transvaal; it reached a peak in 1912 of a value of about $470,000,000; declined in 1913 and 1914; spurted in 1915 in response to war demands and in some

measure because of prosperity in gold-producing countries, and has since shown a consistent decline, the result of the exhaustion of high-grade deposits.

Basic Patents

Basic patents were sought by MacArthur and his associates in 1887 and 1888. The first specification—Great Britain, Oct. 19, 1887, No. 14,174—emphasized, first, the efficiency of cyanide as a solvent, without the aid of electricity from an external source, or chemicals other than cyanide, and, second, the superiority of dilute solutions. The second specification—Great Britain, July 14, 1888, No. 14,223—discussed the use of alkalies and outlined methods of application; the essential feature, however, referred to the use of zinc as a precipitant, "in a state of fine division." The use of shavings, cut from sheet by means of a sharp tool, has remained standard practice to the present day. In 1894 the British patent was held invalid, a decision that was appealed. In 1895 the patentees were permitted to modify the first claim, in referring to the strength of solutions used, whereupon the validity of the patent was reaffirmed.

United States Patents

United States patents covering the cyanide process comprise No. 403,202, issued on May 14, 1889, for the extraction phase of operations; and No. 418,137 and No. 418,138, issued on Dec. 4, 1889, for the precipitation process. The specifications mention the ores suitable for treatment. The value of dilute solutions is stressed as indicating a method by which the concurrent extraction of base metal associated with the gold and silver could be minimized. The strength of the solution to be used was specified as not to exceed "eight parts of cyanogen to one thousand parts of water." This maximum, however, has seldom or never been approached in the practical operation of the process on a large scale. Particulars of patents issued in some other countries are as follows: Natal, Sept. 11, 1888, No. 32; New South Wales, Sept. 27, 1888, No. 965; Tasmania, Sept. 29, 1888, No. 609.

Prior Applications for Patent

Applications for patent, prior to the MacArthur-Forrest claim, covering the use of cyanide solution for the extraction of gold and silver from ore, had been numerous. In particular, J. H. Rae obtained a United States patent in 1867; but he specified the use of an electric current from external sources as an essential auxiliary. J. W. Simpson's patent, issued in 1885, was of promising application; but the plate-zinc method of precipitation proposed was impracticable. Many other attempts were made to solve the problem; but it remained for MacArthur and the Forrests to utilize the application of a well-known reaction by providing a simple and effective method of recovering the gold and silver from the resulting solution. These investigators, to quote Philip Argall, "evolved order out of chaos, achieved a brilliant success where others had failed, and finally gave to the world in the process that bears their names one of the most marvelous though simple methods of ore treatment the human mind has ever conceived."

Early Litigation

The commercial organization that sponsored the early experimental work at Glasgow and subsequently controlled the basic patents in Great Britain was known as the Cassel Gold Extracting Co. In South Africa, the Gold Recovery Syndicate contracted to purchase the rights, subject to a successful demonstration of the process. On arrival at Capetown with the necessary equipment in 1890, Alfred James found that Dr. Wehrner von Siemens had been granted a patent for a cyanide process, using electricity, and that this had been issued shortly after the MacArthur-Forrest company had received its patent. Action for revocation of the Siemens' patent was started, but the attorneys chosen proved to be representing both parties! Later, at Pretoria, it was found that a technical difficulty had caused a delay in the acceptance of the MacArthur-Forrest application, and that the Siemens representative could prove priority. A second revocation action was started there. The result of these trials, the first of their kind in South Africa, was that a decision was handed down in favor of the MacArthur-Forrest company.

Patents Canceled in South Africa

After a successful demonstration of the process at the Salisbury mine in May, 1890, the local syndicate obtained the rights and controlled the patents until 1896, when the president of the Transvaal Chamber of Mines, James Hay, brought action against the holding company that resulted in their cancellation. Royalties imposed were usually on the basis of 10 per cent of the value of the gold produced; but after this verdict no payments for the use of the process could be collected in South Africa.

In spite of the technical importance of the cyanide process, its effect on the development of South Africa and its influence on world economics, the inventors and pioneer engineers reaped little or no net return for their initiative, perseverance, and energy. The action in South Africa that ended so disastrously for the sponsors of the process was due largely to the antagonistic attitude of mine owners, an attitude that was created by the tactics of the local syndicate that controlled the patents.

(To be continued)

Britain Produces Synthetic Nitrogen

IN A LECTURE delivered at Edinburgh on July 7, G. P. Pollitt, as reported in *Chemistry and Industry* (London), gave some interesting information on the development of the synthetic nitrogen industry in Great Britain. During the period 1921 to 1926 the production of nitrogen has nearly doubled, and for economic reasons this increase has been covered by synthetic, not natural, nitrogen. Furthermore, the synthetic product is gradually replacing Chile nitrate. The production from the other source of nitrogen—namely, byproduct ammonia, is almost stationary.

The Haber-Bosch process holds the field today to the exclusion of all others. A plant has been erected at Billingham, near Stockton-on-Tees, England, for the manufacture of 250 tons of ammonium sulphate per day. This plant is producing 65 tons of ammonia daily, and most of this is converted into sulphate.

Here Pollitt makes a point of especial interest to mining men: the sulphate radical required to fix the ammonia is obtained not from sulphuric acid but from anhydrite. This is found to be much more economical than acid, and the company is itself exploiting a deposit of anhydrite, found near the plant at a depth of 700 ft., to supply all its requirements. Further units are being added to the Billingham plant and its production is to be increased.

USEFUL OPERATING IDEAS

Building Up Tailing Piles at Miami

Temporary Dams Built of Sand on Dump by Ditching Machine

FLOTATION TAILING is characterized by fine grain size and does not present the same difficulty in handling as is involved with tailings of coarser grain size. At the Miami plant, Miami, Ariz., the main tailing flows approximately 12,000 tons solids per day, and with accessory water is conducted away from the plant by a

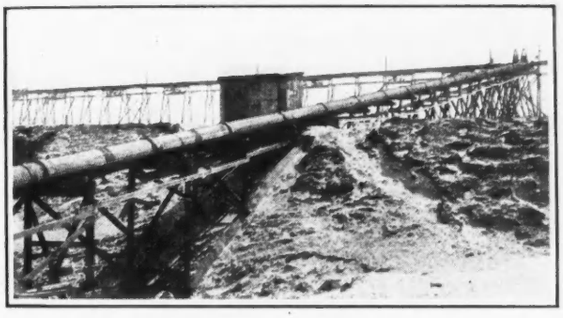


Fig. 1—Wooden stave pipe bringing tailing to the distribution launders

wooden stave pipe which rises to a trestle upon which the pipe is extended upon a slight downgrade, connecting with an open launder also carried upon wooden bents. Discharge gates are placed at intervals along the wooden stave pipe and along the launder. Pipe and launder are placed near the edge of the tailing pile, which now covers an area of about 100 acres and has been built up by suc-

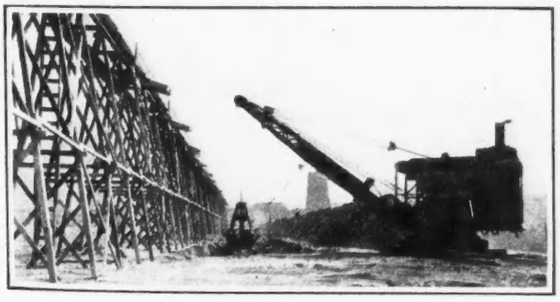


Fig. 2—Railway ditcher constructing low dam at edge of pile

cessive increments to its present height. The tailing discharges through four or more outlets at one time and is directed toward the edge of the pile, but is prevented from overflowing by a low dam constructed by excavating the necessary material with an orange-peel bucket and railway "ditcher." The ditcher, in effect a full-revolving locomotive crane, is supported upon wheels and sill timbers as shown in the accompanying illustration. About 140 ft. of dam 6 ft. in height is constructed per day. As soon as a section of dam is completed, tailing is turned into it and flows away toward the lowest portion, which is occupied by a pond where surplus water clarifies, collects, and is returned for re-use in the mill. The angle of slope is very low, so that in effect the top of the fill is almost flat. While the "dam" is being constructed about the periphery of the area, the part already constructed is receiving tailing and building up to the height of the dam. On completion of the dam, the ditcher is returned and a new lift constructed, beginning upon the level of the new fill. In this way the Miami tailing dump has been constructed and efficient storage of tailing secured. A somewhat similar method is used upon the tailing dump of the Inspiration mill, which is only a short distance away.

How to Test Rock Drill Steel

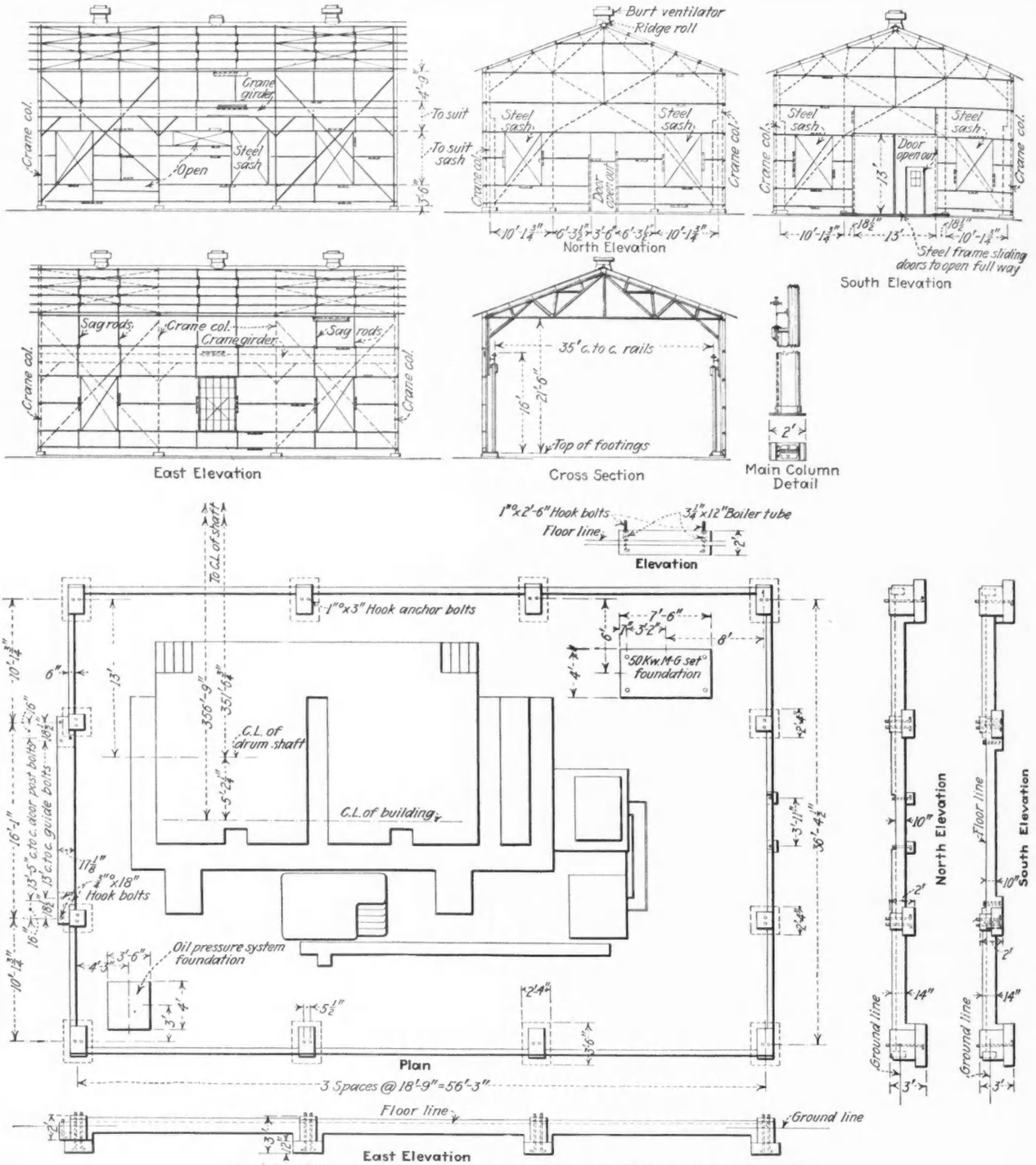
By A. F. Hanly

TO KEEP abreast with the latest improvements in rock drill steel, mines are continually being put to the expense of elaborate tests, many of which never produce really accurate results and seldom lead to a fair comparison of the steels under test. The following method has been adopted by a large mining concern, and has been found to be satisfactory:

An old rock drill is repaired and mounted permanently in a vertical position on a post in the blacksmith shop, and as an anvil a piece of manganese steel, usually an old crusher jaw, is employed. Four pieces of steel, each 4 ft. long, are used as samples for the test. They are inserted in the drill, one at a time, and pounded on the block until breakage occurs, the time for each piece being recorded in minutes and seconds. The break always takes place a few inches from the lower end, and then 2 in. of the metal is cut off the broken end to remove any fatigued metal, and the end is forged into a bit.

Sample drills are taken underground and placed successively in a rock drill and run until dull, a record of the footage being kept. The accuracy of the whole test depends on the air being kept at a constant pressure throughout both the block test in the blacksmith shop and the drilling test in the mine, although the pressures do not need to be the same in both cases.

The average time before breakage in the block test and the average footage before dulling while drilling indicate the toughness and hardness, respectively, of any particular brand of steel and form a basis of comparison between different brands, which is of assistance in determining which one to favor when purchasing.



Detail of Magma Copper Co.'s steel hoist building at No. 5 shaft

Hoist Building at Magma

A NEW HOIST building was recently completed at No. 5 shaft by the Magma Copper Co., of Superior, Ariz. No. 5 shaft is now being sunk and will, when completed, develop the west half of the mine. The building is of steel-frame construction with concrete foundations. Roofing is 22-gage galvanized corrugated steel and siding is of the same material but 24 gage in thickness. Three 24-in. glass-top Burt ventilators are provided in the roof. Windows are in steel sash. The building houses a double-drum hoist, a 50-kw. motor-generator, and the oil pressure unit for brake operation. A 7½-ton crane supported upon a 40-lb. crane rail serves the floor of the building. A 13 by 13-ft. door opening with sliding doors is at one end. The cut shows the foundation layout. The framing details are given above. The building was designed by E. E. Slack, of the engineering staff of the Magma Copper Co. It houses an Allis-Chalmers double-drum hoist; drums 7 ft. in diameter by 9 ft. face, to hold 4,500 ft. of rope; 500 hp. Westinghouse motor, 2,200 volts, 3 phase 25 cycles; and a 50-kw. motor-generator which supplies direct current for the trolley locomotive service from mine to mill.

Discussion

The Dredging of Difficult Ground

THE EDITOR:

Sir—The available areas of workable ground suitable for dredging operations with dredges of standard types are getting very scarce. There are, however, extensive known areas of valuable mineral-bearing placer ground that are not considered as suitable for dredging, owing to the limitations of the standard type of bucket dredge in relation to structural conditions and other factors; but at the same time this type of ground calls for some form of dredging as the only solution from a practical mining standpoint. Here there is an interesting and unsolved problem.

I would like to get in touch with those who own, or may know of, areas of placer ground of the above-named types; and, generally speaking, to obtain data and opinions as to the best way of working ground of the types mentioned, and more especially as to the possibility of designing some type of dredge to meet difficult conditions.

Possible dredge areas have usually been considered only within stream flood plains or stream deltas, generally with false or decomposed bedrock. My own observations lead me to believe that much larger areas of actual stream beds are available, but that because of swift current, uneven depths, hard bedrock, heavy gravel, and occasionally larger boulders, no standard type of bucket-line dredge, however heavily built, could be used to mine deposits of this nature.

I think it will be generally accepted that in most large streams, and nearly all rivers, there are extensive areas of what may be called "no man's land," in that it is too far downstream to be handled by the "hand placer-miner" or even by "wing-dam" operations with the aid of some mechanical equipment, and yet cannot be considered as within the zone of big flats and large bars—or delta conditions—suitable for present dredge operations. Furthermore, it has been my experience in testing to note that these zones are far richer in assay value per cubic yard than the delta areas, the difference being often sufficient to more than compensate for higher current costs, and for operations on a smaller scale, some areas averaging in the neighborhood of a dollar a yard. My observations lead me to believe that the extent and gross value of these zones of at present "no man's land" are far greater than those of the dredgeable deltas that have so far been the subject of exclusive consideration by operators on standard lines. There are areas in California, Oregon, Idaho, and Montana that are not insignificant—and judging from reports of others there are immense areas in Venezuela, Colombia, Peru, Brazil, and other parts of South America, and also considerable areas in British Columbia.

In view of these facts I have attempted to develop a design of dredge for this class of ground, but before going further I would like to obtain expressions of opinion from others with experience, and if possible obtain answers to the following questions:

1. What is the extent and location of any large known areas of placer ground, producing any commercial product—i.e., gold, platinum, tin, gems, or other minerals, of the type as outlined above that could only be worked by some form of dredge-mining, but for which, owing to structural conditions, a standard type of bucket-line dredge could not be considered?

2. What are the general structural conditions—i.e., depth of gravel, proportion of coarse gravel with size, probable number and size or weight of largest boulders to be expected, nature of bedrock, and other factors?

3. What is the average higher ratio of assay value per cubic yard to be expected from these areas of "no man's land" as against the easier ground?

4. What data, if any, are available as to the proportion of heavy concentratable particles, including "black sand," that is found? If possible, give weight in pounds per cubic yard. What experience has been obtained as to "gold loss" as a result of "heavy sand" blocking the riffles? To what extent does "black sand" interfere with effective gold saving operations?

5. What would be your opinion as to the ultimate value of these areas of difficult ground if a practical type of dredge could be developed to work them? Would it possibly give an extended life to the industry as a whole, equal or greater than the record of the industry?

6. Have you any data as to attempts made to dredge or mine difficult ground with special forms of dredges or equipment other than standard; what suggestion can you offer as a line of development for special equipment for this class of work?

7. Are data available as to the assay value per ton of the heavy concentratable sands, and the reduced assay value per cubic yard; and does the valuable mineral occur as associated particles of "free metal" or as "included" particles within the mineral grains? Have you any knowledge of tests regarding the respective assay value of the magnetic and the non-magnetic heavy sand? Do your experience and observation lead you to believe that there is a far larger proportion of heavy concentratable sand in the areas of difficult ground, on the upper reaches of rivers as against the delta areas?

I have taken up a considerable amount of valuable space, but reference to your "Melbourne Letter," page 228, of your issue of Aug. 6, shows that the questions asked are pertinent to the future of "Dredge Mining" as an industry, and that there is a special field for new developments, so I trust that some of your readers will find time to answer the questions.

San Francisco. JOHN M. NICOL.

[We shall be pleased to publish such replies as seem to be of general interest, and to forward others to Mr. Nicol.—THE EDITOR.]

Are Timber Foundations for Sharpeners Necessary?

THE EDITOR:

Sir—I would like to know if any of your readers are accustomed to setting their drill sharpeners on concrete foundations. Certain companies recommend it; others do not. You will doubtless remember the days when we used to erect our stamp mills on timber foundations, even shooting out solid rock to make the necessary room. Early manufacturers of tube mills used to insist that the bearings be mounted on wooden pillow blocks. We all got over this idea, and I am not sure whether the manufacturers of sharpeners who want timber foundations are not still in error. Perhaps some of your readers would give us their experience.

Mexico City. A MINE MANAGER.

NEWS OF THE WEEK

Summary

BUREAU OF MINES to make special research studies of problems involved in the treatment of potash salts.

* * *

Forty-nine first-aid teams and nineteen mine-rescue teams, representing coal and metal mines, quarries and oil-producing operations in thirteen states, compete in sixth international contest at Pittsburgh, Pa.

* * *

New Phelps Dodge smelter at Douglas, Ariz., is blown in; details of construction of the plant include many features to prevent lead poisoning among employees.

* * *

Race to peg sixty gold claims is held near Germiston, in the Transvaal, South Africa, on a tract formerly operated by the New Rietfontein Mining Co.

* * *

Erection of Sullivan Mining Co.'s electrolytic zinc plant at Kellogg, Idaho, progresses according to schedule and should be completed by first of the year.

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Japan offers Soviet Russia goods loan of 350,000,000 yen for monopoly of selling Russian platinum; Soviet expresses unwillingness to agree to terms.

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Bunker Hill & Sullivan Mining & Concentrating Co. purchases United Mercury properties in Valley County, Idaho.

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As a result of the new mining laws and low metal prices more than 20,000 mining titles in Mexico are said to have been allowed to lapse.

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Manganese is a much-discussed subject in the Butte district of Montana; options on deposits are eagerly sought by many interests.

Noranda smelter site in the fall of 1926

Construction of Noranda Smelter Nearing Completion

Plant Ready to Operate Within Sixty Days—To Treat 500 Tons a Day—Full Capacity 1,000 Tons —No. 3 Shaft Completed

GOOD progress is being made with the construction of the Noranda smelter, in the Rouyn district of Quebec, and it is expected that within two months the plant will be ready to treat 500 tons a day. Plant capacity when the work is completed will be 1,000 tons a day, and it is estimated that the crushing section will be able to handle this tonnage in one shift. The plant is being built in two units throughout, which will permit continuous operation in the event of any breakdown and will allow the handling of mine and customs ore at the same time.

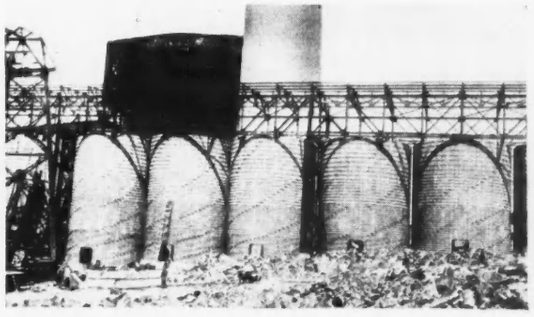
The ore will be taken from the mine in two-ton cars, which will be dumped in a car unloader capable of handling seven cars at a time. The ore goes direct to the coarse crushers, and is then conveyed to the secondary crushing building, where it goes through a series of crushers and rolls. From the secondary crushing building the ore is conveyed through an automatic sampling plant and from there to the bins above the roasters. The automatic sampling plant, as is also the case with the primary and secondary crushing stations, is in two separate complete units. There are four bins above each roaster, which allow for the proper mixture of ore. The roasted ore, which will contain about 10 per cent sulphur, is charged to the reverberatory furnaces and from the reverberatories goes to the convertors.

The entire construction of the plant is steel and concrete. It is well designed and is being built with the best of materials. At present the primary crushing plant is complete except for the installation of the car unloader. The secondary crushing plant is complete and the conveyors from the secondary crushing plant to the bins, and the automatic samplers, are practically complete, but have not yet been entirely housed in. Bins and roasters, with the exception of some of the brickwork in the roasters, are finished. The reverberatory furnaces are well advanced and the convertors are installed. The coal crushing plant and power house have also been completed.

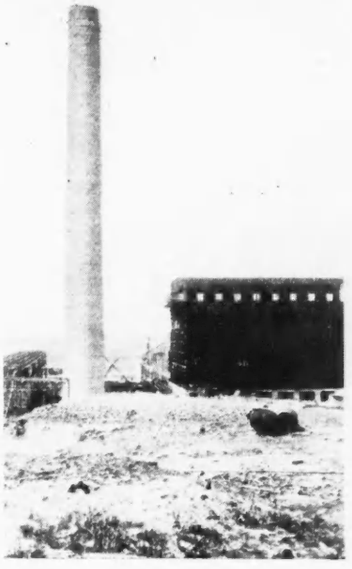
One of the interesting features of this plant is the recuperator, which will introduce a hot blast into the reverberatories at the point of entry of the coal dust, so that the oxygen necessary for the consumption of coal will be at a high temperature. By this means it is expected to lessen the fuel consumption materially. It is also expected that more waste heat may be available than is necessary for the recuperator, and there will probably be sufficient surplus to run waste heat boilers. The new No. 3

At the Noranda Smelter, In the Rouyn District, Quebec, Canada

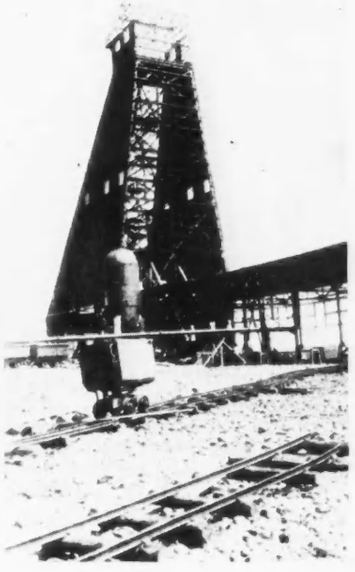
Perrault St., Rouyn



Smelter coal bins



Stack



No. 3 shaft

Smelter

Secondary crusher

shaft on the property has now been completed, and is being used to hoist the waste material from the widening of the drifts. This shaft is down 500 ft., but no underground work is being done below the 300 level. The only underground work at the present time is the widening of some of the main haulageways and the opening up of the stopes. Diamond drills, however, are being operated, but no attempt is being made to develop new ore until after the underground work is completed and the smelter is in operation.

Announcement has been made that the British Metals Co. has completed an arrangement with Noranda Mines, Ltd., whereby the first-named company will secure the entire output of blister copper from the Noranda smelter over a term of years at a sliding price scale. The copper will probably be refined on the Atlantic Coast at the outset. Sale of Noranda's blister copper was arranged after keen competition between the various refining companies.

More Activity Expected in Pioche District

THE Bristol Silver Mines, at Bristol, Nev., are shipping 60 tons of ore daily from the 1,050 level, with a small tonnage coming from the upper levels. The most important development work being done is the continuation of the South West drift on the 1,200 level to intersect the May Day and Gypsy fissures. In the upper horizons of the mine important orebodies were struck at these intersections.

The Pan American Mining Co., of Los Angeles, will soon start intensive development of its mines in the Comet district. The properties recently taken over include the Stella, Mount Comet, Central and Albert groups. J. W. Randolph, of the company, left early in August for Paris, France, to complete financing arrangements.

Owing to the reduced tonnage of ore being shipped from the Combined Metals mine at Pioche, the Union Pacific will reduce the present train service over the Pioche branch line. The railroad plans on two round trips to Pioche during the week. This service will take care of the present tonnage.

Riverside Portland Cement Company Sinks Shaft

The Riverside Portland Cement Co., operating at Riverside, Calif., has begun sinking operations on its four-compartment main hoisting shaft. Complete surface equipment, including a 3,000 cu.ft. air compressor, has been installed for this work. The shaft will be used in underground limestone mining operations. A modified caving method of extraction will be adopted. The limestone will be sent to the company's cement plant at Crestmore, Calif. Work now being done is under the direction of C. A. Robotham.

Many Small Operations Current in Alaska

Deposit of Scheelite Discovered in the Salmon River District at Riverside Mine

A DISCOVERY of scheelite was recently made in the Salmon River district. The deposit was found in the Riverside mine. It has been developed for a length of 60 ft., and averages 5 ft. in width. A shoot of copper 3 ft. to 8 ft. in width has been exposed in the Mountain View mine for a length of 500 ft. The Dolomi Gold Mining Co. has been organized at Ketchikan to reopen the gold-quartz mine at Dolomi, closed since 1905. Development of the Lake Virginia mine, at Wrangell, has been begun by driving a low level tunnel, which must reach a length of 4,000 ft. before raising to ore. It is stated that engineers have estimated a reserve of about 7,000,000 tons on the property. The Jacob Marty mine, at Windham Bay, is again operating, a tramway having been constructed for a length of 4,200 ft. to connect the mine with the mill.

At Prince of Wales Island the Kassan Gold Mining Co. is operating its mill and shipping concentrates. A shoot of ore averaging good value is reported. The Vermont Marble Co., which has been operating the quarry at Tokeen for the last nineteen years, is opening up new marble quarries at El Capitan and Calder, Prince of Wales Island.

IN THE interior, G. H. Hurlock is developing a large group of copper claims on Kotsina River. Steps are being taken to develop the silver-lead deposits recently discovered at Nebesna.

On the coast a discovery of ore containing important values in platinum is reported from Good News Bay. Frank Laing is arranging to install a mill on his gold-quartz claims at Nuka Bay. In the same camp T. Babcock is milling ore from his mine, and the Alas-Hills Gold Mining Co. is getting ready to start up its mill.

At Chichagof, the Hirst-Chichagof Mining Co. completed the payments due to the original owner of the property. Practically all payments made to the owner were from the production of gold during the last few years. In addition to the payments made to the owner the mine has practically paid for its own development. Recently the company took an option to purchase the Bahrt property, which joins its property on the southeast. The underground station and skip pocket for the new shaft, to be sunk to the 500 level, have been completed, and sinking operations should be under way soon. The main level track has been completely overhauled for the purpose of using storage-battery locomotives. To date three major oreshoots have been developed, and production continues on a three-shift basis. The West Coast Development Co., of Tacoma, is developing a property located between the Hirst-Chichagof and the Rust-Chichagof mines. On this property is a vein varying from 14 in. to 3 ft. in width, traceable for 1,600 ft., carrying good values in free gold.

Alaska Glaciers Mining Co. is developing a gold property on Prince William Sound, and proposes to install a mill. Rich gold quartz is reported from the Devenney mine, on Mineral Creek, west of Valdez. Ore of high grade is reported from the 300 level of the Ramsay-Rutherford mine, on Valdez Glacier. At the Mayfield a vein varying in width from 4 ft. to 9 ft. gives good values in gold. The mill building of the Merill mine, at Port Wells, is completed, and the mine should be on a productive basis by fall. Selenium is reported to be an associate of copper at Rua Cove, on Knight's Island.

ORE shipments from Alaska for June show a drop to $591,167, compared with $1,200,213 for corresponding month of last year.

At Moose Pass, R. B. Heaston is operating a mill on his property. The Bill Fairman gold-quartz mine is under development. Gold-quartz discoveries are reported from Nixon Creek, in the upper Kuskokwim.

A hydraulic plant is being installed on Mason Creek, a tributary of the Yukon River. Bedrock is at 14 ft. and the ground is thawed. L. J. McCarthy & Co. are taking out ore from a gold-quartz vein on Fairbanks Creek. The oreshoot is traceable for approximately 1,000 ft.

The American Creek Dredging Co. is transporting 300 tons of dredging machinery and supplies from Fish Creek on the Tanana to its holdings on the upper creek. Plant machinery was supplied by the Yuba Construction Co. of Marysville, Calif., and the company is under contract to build the dredge and put it in operation. The dredge is to be equipped with buckets of 2½ cu.ft. capacity and will be powered by two Diesel engines, each of 60 hp. It is stated that the company has 2,000,000 cu.yd. of drilled ground of paying grade available.

About thirty miners are working in Poorman Creek. Groups of miners are also busy on Flat, Greenstone, Duncan, and Ruby creeks. The Fairbanks Exploration Co. is at work on its power plant. The siphon installations are 50 per cent completed.

At Nome, the Connolly mine, in which three shafts were sunk an average of 100 ft. to bedrock, has produced good dumps of pay gravel. The Goldsmith Dredging Co., of Spokane, resumed dredging operations on Solomon River in the middle of July.

The American Mining & Milling Co. has resumed development of its holdings on Fish Creek, about 7 miles north of Hyder. L. Hansen, of Ketchikan, has purchased a quarter interest in the Engineer group on Texas Creek. The Riverside mine is steadily operating and has shipped 374 tons of concentrates so far this season. A new galena orebody has been developed in a vein 3½ ft. wide on the 425 level.

Much Interest in Manganese Concentration at Butte

Domestic Manganese & Development Co. Erecting New Plant—Options on Deposits Sought

ONE of the principal topics of conversation among mining men in Butte and Philipsburg, Mont., is the new manganese roaster and concentrator that is being erected by the Domestic Manganese & Development Co. in the former plant of the Butte Reduction Works, by John H. Cole and associates. The Chicago, Milwaukee & St. Paul is building a spur and trestle from its main line to the plant. This spur will be 3,200 ft. long and the trestle of sufficient height so that ore can be dumped from railroad cars directly into the head of the mill. Some of the ore, especially that from the Emma mine of the Butte Copper & Zinc Co., will be sampled at the Washoe sampler of the Anaconda Copper Mining Co. before being roasted at the new plant. It is believed that a "milling-in-transit" freight rate will apply on ores sent in from points outside of Butte, and miners and prospectors are busy getting options on the many manganese deposits in Butte and the outlying districts. Although the "black" and "pink" manganese ores were successfully concentrated by water during the war by Carl J. Trauerman, at the Ophir mill in Butte, at the new plant magnetic separators will be used, as by this means higher recoveries and higher-grade concentrates can be obtained. Thus in a measure the difference between present and war prices for the product will be counteracted. In order to investigate the manganese possibilities of Montana, Vern C. Woolley, economist, Neal J. Halpin and Paul M. Tyler, of the U. S. Tariff Commission, of Washington, D. C., are now in the field.

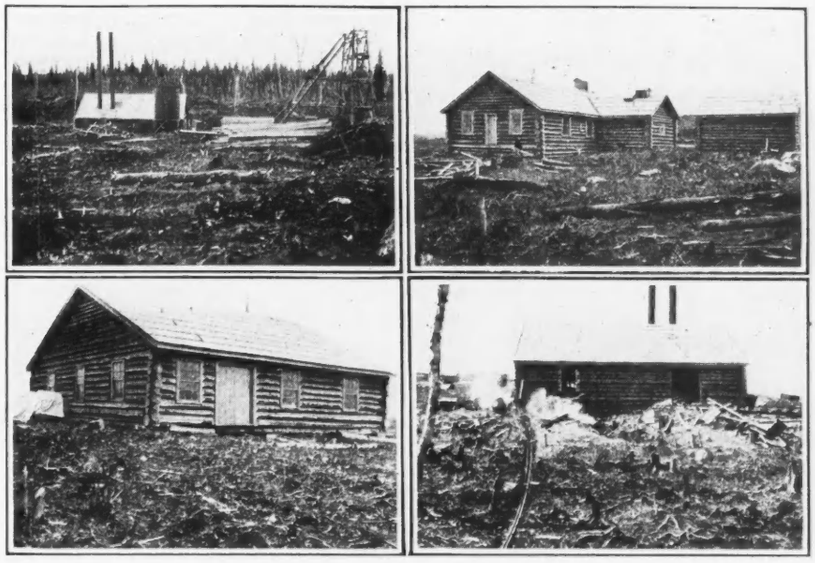
Edward F. Goltra, president of the Mississippi Valley Iron Works, St. Louis, recently arrived at Philipsburg, Mont., to investigate manganese deposits for the purpose of obtaining a supply for his company.

According to persistent reports prevalent in Butte, the Otisco Mining Co., controlled by Lewisohn interests, expects to extend its shaft to a depth of 1,000 ft. and to install larger machinery. It is reported that a consultation will be held between Glenn Anderson, manager, Clinton Bernard, consulting engineer, and Ira B. Joralemon, geologist, in regard to future development plans. The company is shipping ore from the 200 and 300 levels and employs thirty-five men.

Montana-Idaho Mines Corporation has received net smelter returns of over $3,500 from the eighth car shipped from its East Pacific property, near Winston. The ore in the No. 7 west drift has widened and on No. 5 level about 700 ft. west of the shaft the continuation of the old orebody has been encountered, on which no work has been done below this level. The vein on the January group was encountered a few days ago, and ore is being hauled from the Kleinschmidt group to supply the mill, which is about ready to start operations. The company has completed its own hydro-electric plant at a cost of more than $25,000.

Elk Park shaft of Butte Copper Consolidated Mines is 235 ft. deep and will be sunk to the 300-ft. point to crosscut veins showing copper values on the 135 level. The company is taking over the "Jo Dandy" group of five claims situated in the Radersburg district.

Butte Hill Copper Mining Co., managed by Glenn Anderson, has been driving east on a small vein 300 ft. north of the shaft on the 500 level. The drift is now 700 ft. east of the main north crosscut, and from that point crosscuts will be driven north and south to tap five veins which show on the surface of the property.



Howey camp in the Red Lake District of Ontario, Canada

Favorable Progress at Howey Camp

Shaft Down 300 Ft. With Stations Cut at 125 and 250 Ft.—Plan to Open Four Levels Simultaneously

WORK is progressing favorably at the Howey camp, at Red Lake, Ontario. The shaft is now down 300 ft., with stations cut at the 125 and 250 levels, and one sump at the last-named level. The program is to sink to the 500 level and cut stations every 125 ft., and then to drive on the vein structure, and open up four levels simultaneously.

The equipment on the property includes: Two 60-hp. locomotive-type boilers, one 825 cu.ft. per minute cross-compound Rand compressor, an 8¼ in. by 10 in. hoist, a drill sharpener, and other machinery. The whole plant is carefully laid out and installed with the object of maximum efficiency and speedy economic development of the property. Fuel consumption to date has not exceeded three cords for twenty-four hours of continuous operation, and the cost of sinking the shaft has not exceeded $85 per foot.

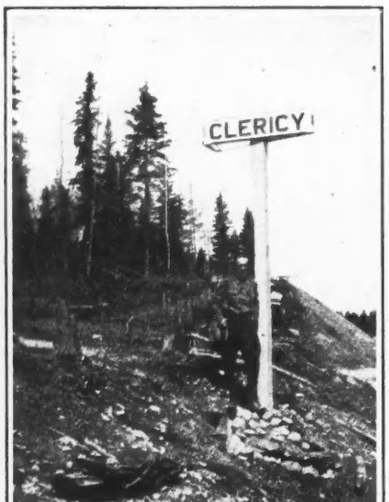
Surface exploration has been carried on with a force of about fifteen men, and so far has been quite successful. Deep trenches have been put down over the vein structure going to the east, with the result that the vein has been picked up in this direction for an additional 780 ft., making a total length now exposed on the surface of 1,715 ft. In most of the trenches free gold has been found in a good width of vein structure in porphyry, and at present rock trenches are being blasted out preparatory to sampling.

All construction has been completed for the comfortable housing of seventy-five employees. One thousand cords of fuel was delivered on the snow for fuel purposes during the summer, and 125 acres of ground was cleared for fire protection. The Schlumberger methods of electrical prospecting were also applied on the property. H. G. Young is resident manager for the Howey Gold Mines, Ltd.

In the accompanying photographs of the Howey camp, the power house and headframe for the 500 ft. shaft are shown in the upper left view, the office and storehouse are seen in the lower left, the dining room and ice storage house in the upper right, and in the lower right, the power house.

Large Acreage Controlled by Clericy Mines, Ltd.

CLERICY Mines is one of the most interesting of the new operations in northern Quebec. The company recently announced the acquisition of two new groups in Dufresnoy Township adjoining the Archean property and on the same geological contact as that property.



Clericy station on the Canadian National Railway

Clericy Mines now possesses more than 4,200 acres of selected ground in Clericy and Dufresnoy townships and ranks as one of the major holding companies in the district, not fewer than eight distinct groups of properties being owned and under development by it. The company plans to prosecute development work vigorously on the Chutes property and to explore the ground thoroughly on the Dufresnoy-Clericy line adjoining the Archean operations on Lake Savard. A 1,000-acre block adjoining Copper-Hill Mines on the west in Dufresnoy Township and a group of claims lying across the Kanojevis River to the east of the railway are also to be explored.

Above is a photograph of Clericy station, on the Canadian National Railway, Rouyn district, northern Quebec — the gateway to Harvie, Copper Hill, Clericy Mines, and other properties in eastern Dufresnoy, Clericy, and Joanne townships. Standing at the sign post is John L. Stratton, engineer of Clericy Mines, Ltd.

First-Aid and Mine Rescue Contest at Pittsburgh

Forty-nine first-aid teams and nineteen mine rescue teams, representing coal and metal mines, quarries, and oil-producing operations in thirteen states, competed at the sixth international first-aid and mine rescue contest, held under the auspices of the U. S. Bureau of Mines, at Pittsburgh, Pa., Aug. 30 and 31, and Sept. 1. The states represented in this demonstration of approved methods of saving life in the mineral industries were: Arizona, California, Colorado, Illinois, Indiana, Kentucky, Maryland, Pennsylvania, Louisiana, Montana, Utah, Virginia, and West Virginia. The governors of numerous important mining states designated representatives to attend the contest. A large number of mine officials especially interested in the subject of mine safety methods were present to observe the competition. The Bureau of Mines made the contest the occasion for calling in the members of its considerable force of field men for the purpose of instructing them in the latest mine safety and mine rescue methods.

New Phelps Dodge Smelter at Douglas Blown In

PHELPS DODGE'S new smelter at Douglas, Ariz., was blown in on Aug. 18. Consignments of ore from the Shattuck and Copper Queen mines, at Bisbee; the Grand Reef mine of Aravaipa, and from several other mines were already on hand, as the smelter had been buying up ore for two months previous to starting operations. The plant consists of an automatic sampling and crushing department, a nine-hearth roaster, blast furnace, storage bins, sintering machine, lead kettles, casting machine and bag house. The automatic sampling room is in charge of bonded employees, but in its operation is mechanical throughout.

Each furnace charge is made up in an automatic weigh car, which mechanically apportions the ores, coke, and flux for a four-ton charge. Precautions have been taken to prevent the escape of lead-laden gases. Every machine and kettle is hooded and equipped with suction pipes which carry the fumes to the dust chamber. Throughout the plant the utmost pains have been taken to guard against any possibility of lead poisoning among employees, whether from dust or gases. Lunch rooms and change rooms for workers coming off shift are being installed. The smelter was designed by A. G. McGregor, of Warren, who is now in South Africa for British interests. Erection was in charge of Dwight P. Robinson & Co.

Bunker Hill & Sullivan Buys More Mercury Properties

Purchase of the United Mercury properties, situated in Valley County, 18 miles southwest of Yellow Pine, Idaho, by the Bunker Hill & Sullivan Mining & Concentrating Co., has been announced, a transaction said to involve $1,500,000. This deal is distinct from the purchase of other cinnabar mines from the United Mercury Mines Co. by the Bunker Hill & Sullivan interests completed in July. The mines are in operation now, and machinery to enlarge the scale of operations is being installed.

Washington Letter

By Paul Wooton
Special Correspondent

Bureau of Mines Assembles Data on Treatment of Potash Salts

WASHINGTON, Aug. 29.—All available information in regard to the treatment of the various salts of potash is being assembled by the U. S. Bureau of Mines and special studies are to be made of treatment problems. The presence of various potash salts over a wide area in the Southwest has been proven. It is believed places will be found where the potash deposits are extensive and where the percentage of potash is higher than at the points where samples have been taken.

While the prospecting is going forward the Bureau believes it is justified in carrying on a certain amount of research looking to the cheapest possible processing of the material found. It is recognized that transportation costs constitute one of the greatest obstacles in the path of the utilization of these resources. For that reason every effort will be made to work out economies which will allow for the widest possible distribution of the domestic material. A certain amount of research in that direction is necessary, also, to determine just what grade of potash salt would constitute a commercial deposit.

Well No. 4, in Ector County, Tex., on Aug. 27 had reached a depth of 1,163 ft. The well was churn-drilled to a depth of 930 ft., when an anhydrite formation was encountered. The casing then was cemented and coring started. At the time of the report the drill had penetrated 233 ft. into the salt and 100 per cent of the core had been recovered.

Arrangements have just been completed under which the Bureau of Mines will make a thoroughly representative moving picture of the operations in connection with the production of iron. The pictures will deal almost entirely with mining operations; they will not follow the metal further than the pig-iron stage.

Civil Service Examination for Junior Metallurgist

The U. S. Civil Service Commission announces an open competitive examination for the position of Junior Metallurgist. Applications for the examination must be on file with the commission not later than Sept. 17. The examination is to fill vacancies at the Engineering Experiment Station, U. S. Naval Academy, Annapolis, Md., and vacancies occurring in the federal classified service throughout the United States. Full information concerning the examination may be obtained from the U. S. Civil Service Commission, Washington, D. C.

Toronto Letter

By Our Special Correspondent for Northern Ontario

Aldermac Shaft Completed to 500 level—Amulet Increases Drilling

TORONTO, AUG. 20—At the Aldermac property, which was formerly known as the Alderson-McKay, the shaft has been completed to the 500 level, and at this point crosscuts have shown a width of 30 ft. of sulphides. At a point 170 ft. west of this diamond drilling indicated a width of 90 ft. of sulphides, and the same orebody appears to have been cut with the diamond drill at a vertical depth of 1,250 ft., where two sections of ore, separated by barren rock, give a total width of 34 ft. of sulphides. One of these sections is high-grade ore. The mine gives indications of being able to produce a large tonnage of ore at a very low cost. What the average grade will be is not yet known, and it will probably take six months' development before the property is opened up sufficiently to permit of this estimate and also to enable the management to decide on a mill. It is altogether probable that a mill of 500 tons' capacity a day will be built. The ore contains practically no zinc, and it is understood that preliminary tests indicate a very satisfactory separation of the copper.

AT THE Dome Mines of Porcupine, the deep-level winze has now reached a depth of 3,100 ft., from which point exploration work will be started. As the winze is in the porphyry, in which the Dome has found very little ore to date, it will be necessary to do considerable diamond drilling before undertaking any comprehensive scheme of development. It is understood that diamond drilling from the 16 level has cut some small but interesting sections of ore on the same horizon as the 17 level. These, however, are a long distance away from any workings on the 17 and will probably have to be reached from the 16 level. Aside from this, there do not appear to have been any recent discoveries, and broken ore reserves are understood to be getting smaller. The future of the mine will depend to a very large extent on what is found in the deep level winze. The completion of the winze was expected by the end of the month, but it actually was finished by the middle of the month. A feature of this work was the advance during the last thirty-one days of 302 ft., a new sinking record for this part of the country.

At the Amulet three diamond drills are at work and two more are being brought in. The three drills are working on what is known as the No. 4 area, which is the scene of the latest ore discoveries. The different orebodies are being outlined and new bodies are also being located from time to time. Of the last seventeen holes drilled fifteen penetrated commercial ore. The ore in this section is overlain by a shallow capping, so that surface exposures are rare. The appearance of these rocks, however, indicates that the ore depositions underlying may be quite extensive. It is reported that the Amulet contains more zinc than any of the other properties.

At the Abana mine the surface showed two veins 5 to 7 ft. wide and about the same distance apart. A shaft was sunk to a depth of 200 ft., and at the 100 level one of these veins was crosscut where it showed a width of 9 ft. consisting of three sections, one of high-grade copper-pyrite followed by several feet of mixed copper and zinc and with high-grade zinc blende on the other wall. At the 200 level the other vein was crosscut where it showed a width of 15 ft. with the same conditions, which is a high-grade zinc and copper section with a central core of mixed sulphides which will have to be concentrated.

The T. & N. O. grading of the Nipissing Central extension into Rouyn is practically finished and the laying of steel has been started. It is expected that a branch will be built into the Aldermac as soon as the laying of steel has reached that point, as there is a very large deposit of gravel at this property. There is already a branch into the Waite-Montgomery, and the Horne has of course good railway facilities.

The new mill at the Gold Hill is practically completed and it is expected to be in operation by Sept. 1. The mill has a capacity of approximately seventy-five tons a day. Underground stopes are being opened up, and it is understood that there is enough broken ore to meet present requirements. This property has a narrow vein and the management expects to carry narrower stopes than have yet been found possible in this country.

Two New Options Taken in Joplin-Miami District

The Federal Mining & Smelting Co. has taken a drilling option on the S. S. & G. mine and Roanoke leases, in the southern end of the Picher, Okla., section of the Joplin-Miami field. Several drills will be placed at work on the property at once.

The Childress Lead & Zinc Co. has taken a drilling option on the No. 1 lease of the Vantage Mining Co., situated in Picher. The south portion of the lease will be thoroughly drilled.

Improvements are being made in the Acme mill of the Missouri-Kansas Zinc Corporation. The property was closed down recently when a portion of the ground caved in, demolishing one of the company's mills.

Development work has been resumed at the Adams mine of Harry Payne Whitney, in the western part of the district. It is expected that the property will be placed in operation again in the current month.

London Letter

BY W. A. DOMAN
Special Correspondent

Japan Offers Soviet Russia Goods Loan for Monopoly of Selling Platinum

LONDON, AUG. 16—Further information received concerning Japan and Russian platinum is to the effect that the Far Eastern government is willing to grant the Soviet authorities a goods loan of 350,000,000 yen in return for the monopoly of selling platinum. So far the Soviet is unwilling to agree to the terms. As the price of the metal has fallen considerably since production started in the Transvaal, the companies operating are not meeting with the success that was expected of them.

As prices of base metals are by no means firm, experts are beginning to investigate the position. At the moment they seem to be mainly occupied with tin, and two views are held as to the future. One party argues that as the metal seems to be unable to recover to £300 per ton, but recedes again on any rally, the £300 mark is too high. It is admitted, however, that, as good profits have been earned in the past at £200 and even at £150, there is no need for anxiety as to the industry.

AFRICA seems to be always to the front where minerals are concerned, and cablegrams from Johannesburg intimate that the Anglo-American Corporation of South Africa and the Consolidated Gold Fields have acquired options over manganese deposits in the Postmasburg district of the Transvaal. There is talk of an American syndicate endeavoring to secure control of one local company's output, but difficulties have arisen in connection with the construction of a railway to carry the ore to the coast. Freight rates, it would appear, would be uneconomic.

Optimistic accounts have come to hand from Tanganyika Territory concerning tin discoveries there, and in some quarters the proverbial grain of salt is requisitioned, when discussing them. From what can be gathered ore is on the properties that have been recently floated, but the lack of transport facilities makes engineers here doubtful of the estimates of working costs. Believing that supplies will be inadequate to meet the industrial demand, great activity is reported from Cornwall, where the search for tin is proceeding almost all over the country and some interesting discoveries, according to recent reports, have been made.

The decline in the price of lead has still further aggravated the district of Linares in Spain. Work at one group of mines has stopped altogether, and 300 men are out of employment. As the mines are rapidly filling with water, they are regarded in some quarters as lost.

Mexico City Letter

By W. L. Vail
Special Correspondent

Mining Operations Continue to Decrease Due to New Laws and Metal Prices

Mexico City, Aug. 19—According to statements made by a well-known mining man of this city more than 20,000 mining titles have been allowed to lapse during the last year, largely because of the irritations caused by conditions of the new mining laws. Also, an extraordinary number of properties has been closed, and heavy reduction of work on others has been necessary, chargeable, according to managements, principally to low metal prices now current. Labor difficulties are minimized throughout the country, and although some trouble between the men and managements is experienced in a few localities, the general labor conditions seem to be improving. Mining organizations continue their opposition to the presidential decree relative to transferring labor disputes from hands of local state boards to the City of Mexico, and it is hoped that some rearrangement may be effected.

Among the properties reported to have suspended operations are the following: Three properties at Cananea, Sonora, with the discharge of some 600 men; the Natavidad, Ixtlande Juarez, Oaxaca, operated by the Peñoles company, is closing temporarily, for alleged changes at the mine; La Fe, Guadalupe, Zacatecas; Mazapil Copper Co.'s smelter at Concepcion del Oro, Zacatecas; two of the properties operated by the American Smelting & Mining Co. at Sombrette, Zacatecas; Campo Morado mines, Guerrero, for years the largest producers in that state, where trouble is reported to be lack of working capital to carry on operations; the lead smelter of the Peñoles people at Monterey, which is closed temporarily; Clarines unit of the San Francisco Mines of Mexico, Ltd., Chihuahua, on account of the low price of lead, which unit includes the Santa Gertrudis, Reforma and Remedios mines; and the Palmillo plant of the American Smelting & Refining Co. at Parral, Chihuahua.

Some rich copper ores have been reported as discovered near the new automobile road going to Acapulco, but conditions are not considered sufficiently favorable for their denouncement. Weekly shipments of lead ores are being made from several small properties on the Balsos River, and near the railway bridge. The power line to Achotla from Temalescaltepec is finished and in operation. It is reported that a well-financed British company has taken over a number of properties in Chiapas. The same concern recently optioned 40,000 hectares of land with large mining rights in the Republic of Panama. San Antonio y Anexas properties, at Zacualpan, state of Mexico, are making regular shipments of silver-lead concentrates to the smelter. The auto road from Taxco to Chontalpan has been completed and machinery for the 150-ton mill at Xitinga is now being delivered at the mines. San Sebastian mines, at Charcas, San Luis Potosi, are being unwatered by the American Smelting & Refining Co. The 1,000,000 gal. fuel tank at Charcas was recently destroyed by fire and 600,000 gal. of oil lost in the fire.

The Majestic Mining Co. has finished re-timbering its main shaft at the mine in the Totoloapam district, Oaxaca, and expects to start its mill within the next thirty days. It has added fifty tons to the daily capacity of the mill. F. J. Filsinger, formerly with the Real del Monte, Pachuca, is mine superintendent.

Zinc production in Mexico for the first quarter of the present year, according to official statistics, amounted to 24,030,885 kilos, an increase of 158.12 per cent over the corresponding period of last year.

REPORTS from Guerrero state that the Peñoles company is expending large sums in getting ready for operations at the Suriano mine. A number of specially constructed river boats have been launched on the Balsas, to ply between the railway bridge and Temixco, where the principal works are being erected. An aërial tramway, seven kilometers long, has also been completed between Temixco and the mines. The ores will be treated by cyanide at the plant and the zinc bullion sent to the City of Mexico for refining. The Pompei gold mine, near Coyuca de Catalan, has discharged a number of men and is limiting itself to development work. A British company, recently organized here, is preparing to take over and work the Santo Cristino property formerly known as the Pinzan and now owned by Emilio Nolte and J. G. Mowat.

J. V. N. Dorr Establishes Prize in Metallurgy

John Van Nostrand Dorr, president of the Dorr Company, engineers, has established, at the South Dakota School of Mines, a prize of $100, to be awarded each year at commencement. The prize will be given to that student in metallurgy who by work accomplished, character, and general fitness gives promise of high accomplishment in the metallurgical field.

Construction of New Zinc Plant Up to Schedule

Construction of the Sullivan Mining Co.'s electrolytic zinc plant at Kellogg, in the Coeur d'Alene district, Idaho, is progressing according to schedule, and it is expected that it will be completed by the first of the year. The main building, which is of steel construction, is now under roof, and steel for the electrolytic building is arriving.

Johannesburg Letter

By John Watson
Special Correspondent

Race to Peg Gold Claims Held Near Germiston in the Transvaal

Johannesburg, July 26—A rush, or race, to peg sixty gold claims took place at Dr. Dyer's farm, about five miles from Germiston, on July 18. The claims included the ground formerly worked by the New Rietfontein Gold Mining Co., which sank two shafts on the tract. About fifteen years ago, the mine was closed, as it was said the company had lost the reef. In the early days nuggets of gold were often found on these Rietfontein mines and osmiridium occurred in places along with the gold. The spot is picturesque, lying on the slope of a hill overlooking Edenvale, with the Modderfontein dynamite factory in the distance. A sergeant of police lined up the starters, who had to run a distance of about 400 yd. to peg their claims.

The government mining engineer, Dr. H. Pirow, and the Pretoria mining commissioner, C. J. N. Jourdan, left Pretoria on July 25 for Lydenburg, to inspect the chrome and platinum fields. They will proceed to Pilgrims' Rest and Sabi to inspect the gold fields. From Sabi they will go on to Barberton to the asbestos mines, afterward visiting Kaapsche Hoop for gold and Kaapmuiden for talc and magnesite. Visiting Leydsdorp, they will inspect the mica and corundum fields; at Bandolierskop and Louis Trichardt they will visit more corundum deposits; then, going on to Messina, they will inspect the copper mines. They then visit Sita, to see the diamond mines, completing their tour by visiting Zontspan salt mines and returning to Pretoria by Aug. 20.

With the British Metal Corporation and the Tanganyika Concessions, the Zinc Corporation, Ltd., has joined in the formation of a company entitled the British Non-Ferrous Mining Corporation, Ltd., under the chairmanship of Sir Cecil Budd. Percy Marmion, one of the managing directors of the Burma Corporation, is vice-chairman, and the Zinc Corporation is well represented on the board.

Lydenburg Platinum Areas, Ltd., on the company's Maandaysholk section, milled 2,400 tons of ore during June, which yielded 411 oz. of platinum-group metals.

The output of Transvaal gold for June was declared by the Chamber of Mines on July 9 as 855,154 oz., having a value of £3,632,483. Compared with May, these figures show a decrease of 4,325 oz. equal in value to £18,372. Crown Mines' output was 3,979 oz. less in June, but City Deep had an increase of 3,651 oz. The native labor returns show 185,637 "boys" at work on June 30 on the Rand gold mines.

Societies, Addresses, Reports

Mining Congress and Institute at Salt Lake City

Progress of Flotation and the Resultant Smelting Problems Thoroughly Covered—Prof. A. M. Gaudin Presents Theoretical Explanation

By George J. Young
Associate Editor

At Salt Lake City, Utah, on Aug. 22 to 26, 1927, the Western Division of the American Mining Congress held its fifth annual meeting and at the same time the Utah Section of the American Institute of Mining and Metallurgical Engineers held a regional conference. In addition, the General Tax Committee of the American Mining Congress presented a progress report, and the directors of the American Silver Producers' Association held a meeting. The meetings were attended by a representative gathering of Western mining men, technicians, executives, and others.

Opening Sessions

A. G. Mackenzie, of Utah, called the Monday meeting together and introduced L. S. Cates, who presided for the day. Mr. Cates in welcoming the delegates and members of the Institute discussed at some length the dominating position of the United States as a metal producer and particularly called attention to the mining industry in general as being responsible for a large part of the freight-transportation business of the country. He declared that the United States was the greatest producer and consumer of mineral products in the world; that our per capita consumption of copper was double that of any other leading nation; and that likewise in other metals a high per capita consumption ruled. The mineral resources are the backbone of our nation's prosperity, he said, and the present meeting is not only of interest to the immediate members present but bears upon the prosperity of the nation as a whole.

Mr. Cates next called upon the American Mining Congress governors from the various states, and in response thereto Robert E. Tally, for Arizona, stated that though Arizona produced almost half the copper of the United States, the post-war price of copper is 10 per cent lower than the pre-war price, and that all items contributing to the cost of production are 50 per cent higher. As a consequence, he said, the mining industry of Arizona is not very prosperous. Although copper companies reduce costs and increase recoveries, the copper industry as a whole is not prosperous, principally because of overproduction. G. N. Bjorge, of San Francisco, called attention to the dominating position of petroleum in the mineral production of California and the approximate equality of the agricultural and mineral production of that state. Jesse F. McDonald, of Colorado, stated that low metal prices had reduced the rate of mining in Colorado but that now a better feeling prevailed. He spoke against tariff tinkering and the need for greater governmental appropriations for mining, calling attention to the disproportion that exists between agricultural appropriations and those for mining. Ravenel Macbeth, of Idaho, advocated compiling statistics on the expenditures of mining companies for development and mining in individual states and said that by giving publicity to such figures state legislatures can be more readily impressed with the importance of mining. C. L. Berrien, of Montana, stated that the manganese question is one of the things interesting Montana miners at present. R. G. Wayland, of South Dakota, said that mining interests were a small minority in his state. F. M. Smith said that selective flotation will enable the miners of northeastern Washington to again become producers. J. D. Conover, of the Tri-State district, said that his district had been quiet during the last few months, as a result of low metal prices, and that some 13,500 tons of zinc concentrates were now being produced per week, although a number of mines are still shut down.

C. Clarence Neslen, Mayor of Salt Lake City, was next introduced and welcomed everyone to his city in a well-appreciated address.

At the afternoon session, Jesse F. McDonald introduced resolution No. 1, which expressed disapproval of any effort to change the present tariff upon manganese ores. C. W. Corfield and R. J. Corfield, electrical engineers, of the Utah Copper Co., then presented a paper upon electrical shovel operations at the Utah Copper mine.

Industrial Compensation Laws

R. G. Lucas, of Salt Lake City, presented the fundamentals of "Workmen's Compensation Laws and Their Application." He said that there are three basic thoughts underlying compensation acts: First, they represent the application of the police power of the state to promote the public good; second, they are a three-cornered adjustment between employee, employer, and the public in which each has had to surrender some special existing rights for the benefit of all; and third, the theory of the legislation is that the cost of compensation enters into the cost of production and should be carried in the first instance by the industry in question but eventually is passed along and is finally paid by the public—theoretically the public pays the bills. Attempts to pass unjust legislation can be met by consideration of these fundamentals, said Mr. Lucas. One problem is the effort made to secure increase in disability rates by increasing the maximum, although the percentage remains the same. Appeals are made to human sympathy, not to the facts of the case. Percentage increases are invariably based upon the idea of need, but the needs of the individual or family cannot be made the basis for this, as the industry is not responsible for need. The greatest good to the greatest number is the important criterion. Labor must bear part of the expense for its moral effect and must also bear part of the loss for legal reasons. Continuing Mr. Lucas pointed out that there is a limit beyond which compensation cannot go without wage-scale reductions. Western industries cannot pass the costs to the consumer, as they must find their markets in the East or in foreign countries. Thirty-one states of the Union pay compensation benefits less than those of the so-called Western states, and there is no reason why they should be asked to carry the peak load of compensation.

Mr. Lucas touched upon the pressure to include under compensation occupational diseases—only twelve states cover occupational diseases. He pointed out the impracticability, not to mention the injustice, involved in this offshoot of compensation enactment. "See that your state legislatures are not misinformed; keep on the job," said Mr. Lucas.

Mine Taxation Reviewed

A. G. Mackenzie briefly reviewed the diverse methods of mine taxation prevailing in the Western states. McKinley W. Kreigh, of Washington, D. C., sketched the present status of the federal tax situation and stated that he did not believe that there would be any serious effort to change any provision of the law with which mining is concerned but that attempts are being made by national business organizations to iron out obvious troubles in the administration of the federal tax laws.

Frank M. Smith at the close of the session introduced resolution No. 2 calling attention to the curtailment of appropriations for the Bureau of Mines and the U. S. Geological Survey and directing the officers of the American Mining Congress to use their efforts to secure increased appropriations. Francis Thomson warmly seconded the resolution.

Tuesday's sessions were opened by J. O. Elton, manager of the International Smelting Co. He announced the logical plan by which the speakers were to co-operate in such a way as to cover the subject of flotation thoroughly and the problems faced by the smelters in connection therewith. Ernest Gayford, of the General Engineering Co., opened

the discussion by saying: "In the fifteen minutes allotted to me I am expected to be a dictionary for five minutes, an historian for five minutes, and a prophet for five minutes. It is inept for me to define flotation to a group of men like this audience." However, a number of definitions were quoted and he sketched a brief history of the development of the process. He mentioned the progress made in floating copper ores and instanced Utah Copper as an outstanding example, saying that were this company forced to operate under the discarded gravity methods it would have been forced to close down under present conditions.

Frank Wardlaw, Jr., superintendent of the Utah-Delaware mine, described how selective flotation had enabled the mine under his charge, formerly known as the Highland Boy, to continue to produce and to remain in operation when it appeared that it would have to shut down. The mine has been worked for thirty years. It now employs 550 men and produces ore from seventy-five faces, one-half of which are worked on a two-shift basis. It accounts for the support of some 2,500 people.

Paul Hunt, mine manager of the Park Utah Consolidated Mines, told a similar story about the revitalizing of mining in this important Park City group by the results of selective flotation. He mentioned the steady reduction in operating costs, the concessions in freight rates by the railroads, and the increase in production from 145,000 tons in 1925 to an estimated total of 230,000 tons in 1927. Satisfactory smelter arrangements were made and continue with but few changes, and are of advantage to the shipper. The gross production of Park Utah is estimated to be $5,000,000 for the current year, and, of this, fully 40 per cent is directly accountable to selective flotation. As the mine is in one of the smaller counties, its taxes amount to one-half of all of the taxes; it accounts for the support of 17 per cent of the population of the county. Mr. Hunt concluded by pointing out the importance of taxes in influencing mining costs and asked for equitable consideration and more toleration.

E. E. Barker, engineer of mines, Utah Copper Co., concisely reviewed the history of Utah Copper and pointed out the importance of flotation in enabling that property to cope with changing economic conditions. Ore reserves have been recalculated and are now 600,000,000 tons of 1⅛ per cent copper ore. Flotation, he said, has increased the life expectancy of the mine from thirty years in 1923 to forty-five years in 1927. Extraction has advanced from 65 per cent in 1923 to 90 per cent in 1927. In 1926 copper was produced for 7.94c. per lb. Flotation, he said, made it possible for this company to keep pace with changing conditions.

Smeltermen Tell of Difficulties

W. H. Eardley, manager of smelters, Utah district, U. S. Smelting, Refining & Mining Co., stated that the efficiency of blast-furnace work depended upon the proportions of different ores fed to it. Formerly the Midvale smelter received per month 4,000 tons of gravity lead concentrates and 1,000 tons of pyrite carrying 5 per cent lead and 10 to 11 per cent zinc. At present it receives 4,300 tons of flotation lead concentrates containing 60 per cent lead, 4½ per cent zinc, and 8 per cent moisture, and 4,000 tons of flotation pyrite carrying 2 per cent lead, 3½ per cent zinc, and 10 per cent moisture. A lower moisture content than formerly reduced the difficulty of roasting in multiple-hearth furnaces and made it possible to operate them upon 100 per cent flotation feed. Sulphur in the calcines is increased and lower tonnages per furnace rule now. "There is a difference of opinion as to the best way of handling flotation concentrates," said Mr. Eardley, who then described methods in use and stated that the one in most general use was to mix the flotation lead concentrates with other concentrates, pass the mixture through the sintering machine at a fast rate, the first sinter being crushed to ½ in. size maximum, and then passed a second time through the sintering machine. However, he stated that when siliceous ores are available, single sintering is the most economical method. It is important in crushing the sinter for double roasting to get rid of large lumps, to mix the charge thoroughly and to distribute evenly the 8 or 9 per cent of moisture.

More Sintering Machine Capacity Necessary

R. A. Wagstaff, assistant manager, American Smelting & Refining Co., Salt Lake City, said that more sintering machine capacity was necessary with flotation concentrates as well as larger baghouses and Cottrells to take care of the increased flue losses, but that fewer blast furnaces were required. Other conditions of smelting practice were not materially changed, apart from an increased lead content in charge, a more compact lead charge, and higher blast pressures. There is an actual curtailment of tons smelted and number of furnaces operated, as well as an increase in smelting cost per ton.

A. B. Young, of the International Smelting Co., said that the lead blast furnace is a tricky affair and requires correct proportioning of silica, iron, lime, and zinc in the charge. The 60 per cent lead concentrate takes away the zinc, iron, and a good deal of the insoluable, and eliminates the mining of barren iron ores for fluxing purposes. Iron concentrates are a suitable iron flux and allow greater flexibility. Elimination of zinc from the blast-furnace charge reduces the amount of iron required. A cost of 30 to 40c. per unit is necessary to eliminate zinc in the blast furnace. Zinc elimination in slags has been reduced from 50,000 tons to 25,000 tons per annum, resulting in a direct saving of $800,000 to $900,000 per year to the industry.

B. L. Sackett, of the International Smelting Co., said that a similar set of conditions affected the copper smelter handling flotation concentrates. There is decreased tonnage and curtailed smelter operation, as well as increased difficulty in handling the material especially in roasting. Dust losses are increased, on account of the fineness of flotation concentrates, but the greatest beneficial result is the extension in the life of the copper industry.

Paul Billingsley, geologist, pointed out the fact that selective flotation by making low-grade lead-zinc ores available had widened the possibilities of underground exploration and development.

W. Mont Ferry, managing director, Silver King Coalition Mines Co., said that some six or seven years ago the direct-smelting ores of Utah were being rapidly exhausted and smelting costs were almost prohibitive, but at that time one large smelting company had the courage to apply selective flotation on a custom-ore basis and that this had fundamentally changed the mining situation. He pointed out the fact that in 1924 some 24,000 tons of zinc concentrates were marketed, or twice the average yearly production for the period of 1914 to 1923. In 1925 zinc concentrates to the amount of 60,000 tons were sold; in 1926 144,000 tons; in 1927 the output will be 150,000 tons. A gross value of $6,000,000, or $40 per ton, is being returned to the mines. Indirect advantages in decreased costs and absence of penalties have accrued. Of 13,000 men employed in the metal industries, some 2,500 owe their employment to selective flotation. In all, about 20,000 persons are dependent upon this recent development and a daily payroll of about $20,000 is derived which is of great economic value to Utah.

Division Officers Elected

Western Division officers elected Philip Wiseman, of Los Angeles, chairman of the Western division of the American Mining Congress for the ensuing year; F. W. Maclennan, of Miami, Ariz., vice-chairman, and Robert I. Kerr, of San Francisco, secretary. The next meeting will probably be held in Los Angeles in October, 1928. Directors elected were: Arizona, F. W. Maclennan and W. B. Gohring; California, Philip Wiseman and Robert I. Kerr; Colorado, Jesse F. McDonald and M. R. Tomblin; Idaho, A. P. Ramstedt and Ravenel Macbeth; Montana, W. B. Daly and C. L. Berrien; Nevada, J. C. Kinnear and H. M. Rives; New Mexico, J. M. Sully and J. F. Woodbury; Oregon, R. M. Betts and A. W. Strowger; South Dakota, B. C. Yates and R. G. Wayland; Utah, D. D. Moffat and A. G. Mackenzie; Washington, F. M. Smith and Leon Starmont.

Technical Details of Selective Flotation

At the Tuesday afternoon session of the Institute papers dealing with technical details of selective flotation were introduced. G. H. Clevenger presided. Prof. A. M. Gaudin, of the University of Utah, presented a well-worked-out explanation of flotation. He said:

"To obtain a concrete picture of how flotation works it is necessary to follow

the physicist and chemist in considering matter as made up of molecules and ions. Dissolved substances occur either as molecules, ions, or micelles. Molecules are the smallest subdivisions of matter possessing the properties of matter in bulk. They may be classified as: polar, or water-like; non-polar or oil-like; polar-non-polar or water-like in one part and oil-like in another. Ions occur from the splitting of polar molecules or polar-non-polar molecules, resulting in the formation of charged polar or polar-non-polar elements. Micelles are composed of molecules associated in clumps and more or less coated by a layer of ions, which insures their stability and prevents their coalescence.

Phenomenon of Adsorption

"Dissolved molecules, ions, or micelles are distributed in uniformly dense fashion throughout the solution except at the surfaces separating the solution from solid and gaseous matter, where the concentration is either larger or smaller. This phenomenon is known as adsorption. Pure liquids do not froth; solutions are capable of frothing only because of adsorption. Crystalline solids (minerals) are composed of ions, not molecules. For example, in minerals of the cubic system each one of these ions is attached to six neighboring ions by valence bonds, whose strength is one-sixth of the total valence. At the surface of a solid, one of these bonds is missing; as a result, there is a tension at that surface similar to the surface tension of liquids, which can be released by extending the crystal structure with identical or analogous ions.

"Solids are either polar or non-polar. Sulphur and graphite are examples of non-polar solids. Polar surfaces of solids are wetted by water in preference to air. Non-polar surfaces are not wetted by water in preference to air. This is true whether the solid has the same character throughout or only as a skin.

"The essential thing in the art of flotation is to know how to treat ore pulps to make the surfaces of some minerals non-polar as compared with the surfaces of other minerals. This is done by utilizing the tendency of dissolved molecules, ions, or micelles to adsorb at solid-liquid surfaces, as well as the residual affinity of crystal surfaces to combine with certain dissolved reagents. This surface reaction results in the formation of a superficial coating. The coating constitutes a partly complete monomolecular film or layer, when non-polar. When polar, the coating is spotty, polymolecular, and visible under the microscope. Air bubbles adhere to non-polarly-coated mineral grains, but not to polarize-coated mineral grains. Air bubbles must be elastic, so as not to coalesce or drop their load of non-polarly-coated mineral particles. This is obtained by the addition in solution of a substance adsorbing at bubble walls.

"Frothing agents give air bubbles the required elasticity. Collecting agents produce non-polar coatings at the surfaces of certain minerals. Depressing agents form polar coatings at mineral surfaces by reaction with the mineral or with dissolved substances. Modifying agents react with mineral surfaces or other substances in solution to change one of the ions at the mineral surface. Thus, carbonates are superficially coated with sulphides, sphalerite is coated with copper sulphide, calcite with lead carbonate. Toxic agents defeat flotation in spite of no apparent ground for reaction with mineral surfaces, or reagents in solution. Their mode of operation is not fully understood. Antitoxic reagents destroy toxic reagents by precipitation or otherwise. In this class belong those reagents which regulate the acidity or alkalinity of circuit and those which precipitate metallic salts. Frothing and collecting agents are of the polar-non-polar type. Depressing, modifying, toxic and antitoxic reagents are of the polar type."

Professor Gaudin concluded by explaining from a series of figures the phenomenon of selective flotation.

A short discussion followed, and W. J. McKenna, of Tooele, Utah, then described the practice followed in the custom concentrator of the International smelter. R. A. Pallanch, mill metallurgist at Midvale, Utah, discussed the use of sodium sulphite as a zinc depressant in selective flotation and the results obtained at Midvale, where it is in use. R. J. Evans, Jr., superintendent of flotation at the Combined Metals plant at Bauer, Utah, described the successive steps in the development of processes used for the difficult Pioche ores. R. W. Diamond reviewed flotation practice at the Kimberly concentrator of the Consolidated Mining & Smelting Co. A. W. Fahrenwald, of Moscow, Idaho, briefly summarized flotation developments in Idaho. A general discussion closed the afternoon session.

Continuation of Technical Discussions

Flotation continued to be the theme of the Wednesday morning session. Ernest Gayford introduced President DeGolyer of the Institute, who expressed pleasure at the degree of cooperation shown by the Salt Lake section. D. A. Lyon then assumed the chair and Guy H. Ruggles discussed recent flotation practice at Inspiration, Ariz. He stated that after placing the mill upon a lime circuit and xanthate the proportion of xanthate was decreased from 0.3 to 0.05 lb. per ton and finally fixed at 0.15 lb. of xanthate liquor. Sodium xanthate crystals were adopted and the quantities fixed at 0.03 lb. Grade of concentrates is not a serious factor as long as they reach 30 per cent copper. He pointed out that pine oil is added to return water and lime into the grinding circuit.

In the absence of A. T. Tye, of Cananea, the chairman read significant parts of his paper on selective flotation at Cananea. By selective flotation the grade of concentrates has been increased to more than 17 per cent copper and the ratio of concentration from 2.57 to over 10, resulting in a reduction of total daily concentrates from 673 tons to 173 tons, with large savings in transportation and smelting costs. At the smelter, blast furnaces were cut out and concentrates smelted in reverberatories without previous roasting.

W. L. Zeigler, of Gem, Idaho, described the Hecla practice in concentration, and also the Galena flotation concentrator, which is a 150-ton plant of low initial cost, extreme simplicity, and low cost of milling. A total crew of five men, including superintendent and assayer, operate the mill. Power required is 160 hp. and milling cost about 70c. per ton.

Forrester Cells Discussed

E. H. Mohr's paper on the Forrester cell at the McGill concentrator, Nevada Consolidated Copper Co., was summarized by the chairman, as the author was absent. Mr. Mohr pointed out that the new type of cell is more economically operated and greater uniformity of operation is maintained with it. Table concentration ahead of flotation has been discarded as a result of installing the new cells.

In discussing Mr. Mohr's paper, O. E. Keough called attention to the unusual coarseness of the McGill pulp and stated that it was not suitable for the Callow, on this account. He said that at the Tooele concentrator a comparison had been made between Callow and Forrester cells when used in their cleaner circuit, but both cells showed the same recoveries, with, however, an advantage in grade for the Callow cell.

W. B. Cramer said that Mr. Mohr's paper reflected great credit upon its author and indicated the possibilities in improvements and betterments arising from using the Forrester type of cell. He called attention to the high power requirement and stated that at Bisbee only 0.83 kw.-hr. and at Morenci 0.93 kw.-hr. per ton was required. He mentioned the use of the McIntosh cell at Nacozari and said that this cell was using 0.52 kw.-hr. per ton. Both the Forrester and McIntosh cells, he said, were developed by the Phelps Dodge Corporation. Dresser, Diamond, Allen, Gayford, and Collins participated in the discussion.

In discussing Mr. Ruggles' paper, R. W. Diamond stated that at Kimberley, B. C., the experience of the mill men paralleled that of Ruggles at Inspiration, in that lower insoluble was obtained in the concentrate by adding xanthate to the flotation circuit and not to the ball mill. L. O. Howard stated that Mr. Tye's paper was important, in that it raised many questions as to the future of smelting. Many joined in the discussion of this paper, which excited a great deal of interest in that it indicated the effect of selective flotation in altering the smelter problem.

A. W. Hahn, of Salt Lake City, presented a carefully worked out analysis of the conditions and results obtained in the flotation of lead-silver ores. He stated that if the oxidized minerals can be sulphidized and these minerals under

flotation conditions flocculated, then commercial recovery can be obtained. However, the pulp must remain in a dispersed condition during flotation and colloidal slime in the pulp must not exceed 17 per cent, nor must the amounts of oxidized iron and manganese exceed 15 per cent. Much interest was shown in Mr. Hahn's paper.

Round-Table Conference

In the afternoon at the concluding session G. H. Clevenger stated that the object of the session was to find out a basis upon which to continue the investigations upon ball and rod mills which the milling committee of the Institute had initiated. After a brief discussion of W. L. Zeigler's papers, John Gross told about the research work of the Bureau of Mines in determining an accurate measure of work done in crushing. It was finally decided to develop a method for measuring the aggregate surface of a mass of crushed particles. A relative measure of such surfaces was found by determining the rate of solution of quartz particles in hydrofluoric acid. By determining this rate for four time periods and extending the plotted curves to the zero time, a comparable standard was obtained. Mr. Gross said that Dr. Martin, in England, had developed a similar line of research. A small machine was also developed by which the work of crushing could be measured.

Tests for Grinding Balls

Mr. Hatch started the "ball rolling" in the informal round-table discussion by stating that the actual wear of balls in ball grinding is best determined by their use, but that a Brinell test of 550 to 600 indicated a long life. Such a test more than any other is nearer true, he said. A cast-iron ball alloyed with chrome is best for small sizes and forged steel with manganese for large sizes. As may be suspected, a considerable difference of opinion was expressed by different members present. Advocates of alloy steels were active in pointing out advantages of such steels. Mr. Ruggles agreed with Mr. Hatch that the only way to test balls was in the mill. He said that a forged-steel ball of 0.8 to 1.0 per cent carbon and chromium 0.3 per cent best served conditions at the mill in his charge. Clevenger stated that in the smaller sizes a good cast iron is about as good as any material, but that in the larger sizes the question as to ability to withstand impact assumed larger importance. Opinion appeared to be that local conditions and economic considerations were the factors in selecting metals. Practically all agreed that both the milling committee and the Bureau of Mines were engaged in a profitable study to the industry.

The remainder of the meeting, Thursday and Friday, was spent in excursions to Midvale, Bingham, Tooele, and points of interest about Salt Lake City. The meeting was exceptionally well attended by many from the Western states.

Great Hall in Hart House, Toronto University, Toronto

In Canada With the British Empire Mining Congress

By A. B. Parsons
Associate Editor

Toronto, Aug. 26—By this time the members of the British Empire Mining and Metallurgical Congress sojourning in Canada, if they believe what they hear, ought to be convinced of three things. They have heard them repeated frequently enough. Some of the oratory to which they have been treated—or subjected, as the case may be—has been unsurpassed; some has been mediocre. But at Montreal on Tuesday evening, at Ottawa on Wednesday at noon, and at the official banquet at Toronto last night, not to mention sundry less formal occasions, they were told: (1) That they constitute the greatest collection of mining and metallurgical talent that ever has been assembled in the British Empire; (2) that Canada possesses greater undeveloped mineral resources than any other unit in the Empire; and that as plans for exploitation reach fruition Canada will become the greatest mining country in the Empire, if not in the world; and (3) that Canada wants more than anything else to share this prosperity with the home folks in the British Isles, and will do so if Britain will only send over the money with which to finance the development. That outside help is necessary is admitted.

English Capital Desired

Probably the most interesting of these propositions is the last. In any event, it has probably been stressed more than the others. For obvious reasons, it is impossible to obtain entirely accurate data on the point, but it is generally conceded that of the capital represented in Canadian mining enterprise less than 10 per cent is English, and that the remainder is about equally divided between shareholders in the United States and those in Canada. Two reasons are assigned for the small proportion held in the mother country. First, its financial resources were depleted by the war and money is not plentiful; and, second, several rather notorious fiascos have made British investors skeptical of Canadian mining ventures. However, with respect to both of these obstacles some improvement is to be observed, according to the statements of several of the overseas visitors, and one result of the trip should be the attraction of more capital from the other side. If it does not the Canadians will be badly disappointed.

Divergent Views Expressed

One note that runs through some of the speeches is an antipathy to capital from the United States. In urging the English to cast their lot (financially, of course) with the Canadian mining industry, some of the more outspoken frankly say that they do not want "outsiders" to share the fruits of Canadian mining success. They would resist tendencies in this direction. A more moderate view is that advanced by Viscount Willingdon, Governor General of Canada, who at Ottawa said that more capital is needed than the Canadians alone could command, but that they much prefer getting help from within the Empire than from without. He wants to keep things in the family. Still a third attitude is

that expressed by Sir Robert Horne, Honorary President of the Congress. His counsel is to get capital from whatever source it is obtainable. He instanced the development of the resources of the United States and of the Argentine by English capital in the last century. The English may have got a good return for their money, but the greatest advantage accrued to the people in the two American countries. I may say in passing that I have talked with a number of leaders in the mining industry in Canada and they are inclined to make light of the oratorical flights of some of the lesser officials in this connection. They want England to supply all the money she is able and willing to supply; they want all the Canadian capital they can get; and at the same time they want all that the United States can contribute to the cause. They say that there is more than enough opportunity to go around; and this squares with the substance of the second proposition that they have been emphasizing so strongly —that is, the vast extent of Canada's mineral resources. And production figures and geological evidence furnish strong support for their contention in this respect. The first proposition likewise is doubtless true, for an examination of the list of those registered to take the two tours reveals an unusual array of names well and favorably known in the profession throughout the world.

Opening Sessions at Montreal

I shall now endeavor to sketch briefly in chronological order the events of the last three days. Tuesday morning in Montreal the proposal of Sir Thomas Holland to have made a comprehensive survey of the mineral resources of the Empire and of the conditions affecting their future development was discussed, and a resolution embodying the plan was approved. The first formal function was the official dinner held at the Windsor Hotel that evening. Enthusiasm, some excellent speeches, and general *éclat* marked the occasion. The Hon. J. E. Perrault, Minister of Mines for the province, praised Quebec and its mineral resources and extended an official welcome to the visitors. In introducing Sir Robert Horne as the next speaker the chairman, E. W. Beatty, chancellor of McGill University and president of the Canadian Pacific Railway, expressed the hope that Sir Robert came honestly by his many titles. Apparently these titles, as reflected in the many letters appended to his name, are not taken too seriously. Mr. Beatty and Sir Robert are both Scotch and both bachelors; they are able men and brilliant speakers; they had a good go at each other, and the audience enjoyed it.

J. L. Agnew, president of the Canadian Institute of Mining and Metallurgy and also of the International Nickel Co., was extremely brief but quite appropriate in his speech of welcome. Mr. Beatty in introducing him remarked that he was born in the United States but was rapidly overcoming the handicap. The Hon. F. W. Beyers, Minister of Mines and Industries in South Africa, like Mr. Perrault, thought pretty well of the mineral resources of his own country and said so at some length. He then extended a formal invitation to the Congress to hold its next meeting in 1930 in South Africa. Incidentally, this invitation subsequently was duly accepted. The trains left soon after midnight for Ottawa; and Tours "A" and "B" began with their departure.

Ottawa and Toronto Events

Ottawa offered the visitors, after an excellent breakfast at the Chateau Laurier, a variety of motor trips. Plain sightseeing, feldspar mining, hydro-electric power-plant construction, the manufacture of newsprint from wood pulp, the government mint, and the testing and research laboratories of the Department of Mines were among the attractions. For obvious reasons this correspondent cannot give a first-hand report on all of these. Such a report can, however, be given of the luncheon, at which the Governor General of Canada and the Prime Minister made addresses and Sir Robert Horne a short speech.

Of most interest to mining men is doubtless the plant of the Department of Mines. C. S. Parsons, engineer in charge, and his staff showed a large number of visitors through the establishment. In the variety and utility of equipment it is surpassed by few plants of similar character; and it is said to be giving a vast amount of practical assistance to owners of mines and prospects in the Dominion. Large- and small-scale tests can be made, no charge whatever being assessed against the individual sending the ore. Flotation of metallic ores, grinding and sizing of non-metallic minerals, and tests on coal in the fuel department, are the principal activities at present. Some exceptionally valuable work on the selective floating of zinc-copper ores from the Rouyn area, in Quebec, is expected to assist materially in the development of that comparatively new region.

The evening was devoted to an entertainment at the Victoria Memorial Museum, known as a "Conversazione." This consisted of ceremonious presentation of the guests to the Governor General and Viscountess Willingdon, followed by a viewing of a large number of remarkable museum exhibits (for which one was instructed to follow the red line drawn on the floor), moving pictures, refreshments, and finally dancing. For the second night in succession the guests departed only when it was necessary to catch their trains, and again they seemed loath to go.

Yesterday was spent in Toronto at the charming site of Toronto University. Rooms had been previously assigned in the various dormitories, and after a breakfast at Hart House the visitors found their baggage delivered at their rooms. I can see no reason yet for retracting or retreating in anyway from the compliments paid last week to the secretarial staff for the excellent management of the whole Congress. One necessary precaution is: Be guided by one's own watch rather than the clocks in town, for these cities are on a day-light saving basis and the trains and the program of the Congress are operated on standard time. Another "inaugural" session was on the program in the morning at the mining building at the University. The Mayor of Toronto and the President of the University were speakers. Great Hall, in Hart House, was the scene of the official banquet in the evening, the high-ceiling dining room, with its artistic decorations, making a delightful setting for the occasion.

George C. Bateman, once manager of the La Rose mine, at Cobalt, and now secretary of the Ontario Mine Operators' Association, by presiding in very acceptable fashion demonstrated that a good mining engineer can do almost anything that he undertakes. The first speaker, the Hon. Howard Ferguson, Premier of Ontario, frankly confessed that the only way to sell Ontario mines was to "keep the goods in the show window," and he obviously considered his audience to be made up of possible customers. How good a salesman he is remains to be demonstrated in the course of the next year or two. He advocates "strengthening the imperial tie" and told his hearers that "if you will send men and money, and if you come of the right stock, we will share with you the wonderful advantages that we enjoy in this country." Sir Richard Redmayne, chairman of the Advisory Committee on Minerals of the Imperial Institute (London), complimented Canada as a gold-mining country and in eloquent fashion paid a tribute to the late Willet G. Miller. Following this, Charles McDermid, secretary of the Institution of Mining and Metallurgy (London), asked the Ontario Department of Mines to accept on behalf of the Institution the custody of the gold medal awarded in 1915 to Willet G. Miller, in recognition of his eminence as an economic geologist.

Nickel Industry Reviewed

Oliver Hall, of the Mond Nickel Co., then presented to the Department of Mines a replica of an ancient galleon done in pure nickel. It was about four feet high and was a splendid piece of art and craftsmanship. He also traced the history of the nickel industry and suggested what the future held in store. It seems that on his eightieth birthday Thomas Edison predicted that the books of the future would be printed on nickel. On this point Mr. Hall expressed no opinion.

Charles McCrea, Minister of Mines for Ontario, thereupon accepted in behalf of the Department custody of the Miller medal and the nickel galleon. Likewise he presented to the Institution in London a handsome portrait of Sir William Logan, a distinguished Ca-

nadian, aptly described as "the forefather of Canadian geologists."

One thing impressed me about the dinner at Toronto. Some of the sentiments expressed by one of the speakers were not particularly complimentary to the United States. But in the words they used to express their thoughts, in their pronunciation, in their looks, in their manners, and in their mannerisms, Messrs. Bateman, Ferguson, Hall, and McCrea resembled nothing in the world so much as prosperous business men or successful office holders in Detroit or New York City. Propinquity is a powerful influence. Most fair-minded people in the United States will agree that Mr. Ferguson's "insidious reports of eyes and hooks trying to pull Canada away from the British Empire" are exaggerated to say the least. That long imaginary line is in no need of fortification, either with guns or reproachful words.

This and That

OFFICIAL delegates of the United States include, F. Lynwood Garrison, of Philadelphia; R. M. Catlin, of Franklin, N. J., and H. Foster Bain of New York. They have the counsel also of Philip Moore, of St. Louis. Mr. Catlin views his post as being purely honorary. "I am not worrying" he says. "If there should be any work Bain will do it, anyway.

* * *

Naturally, a certain contrast in dampness in this region and in the United States presents a temptation to get off a few wisecracks on a topic that need not be named. However, as Scott Turner, of the U. S. Bureau of Mines, says, it is not an appropriate subject for levity; and your correspondent will restrain any impulse in that direction.

* * *

It must be that professors are better paid than is commonly thought, or else that they are particularly adept at persuading their institutions to send them on field trips, for a large number of them are participating in the tours. Without attempting a complete enumeration the following list is composed of professors of mining or metallurgy with whom I have talked:

B. W. Holman, Royal School of Mines, London; I. M. Marshall, University of Illinois, Urbana; H. Ries, Cornell University, Ithaca, New York; G. A. Watermeyer, University of Witwatersrand, Johannesburg; J. A. Ritson, University of Leeds, England; G. A. Guess, Toronto University, Canada; Ellis Thomson, Toronto University, Canada; C. O. Bannister, Liverpool University, England; P. Saldau, Mining Institute, Leningrad, Russia; Rudolf Vondracek, Czech Technical College, Czechoslovakia; S. J. Truscott, Royal School of Mines, London; G. S. Stanley, University of Witwatersrand, Johannesburg; Robert K. Warner, Yale University, New Haven, Conn.; W. G. McBride, McGill University, Montreal, Canada.

* * *

Possibly there will be a change later on, but to date the technical sessions have been about the most perfunctory we have ever seen—and that is saying quite a lot. The beautiful weather, the counter attractions in the line of golf and excursions, and the preference of the delegates for staying out in the halls and chatting, leave a small minority to attend the meetings. Perhaps the committee foresaw this when it sent out printed copies of the papers beforehand. Or perhaps this is the cause and the lethargy the effect.

* * *

As a matter of fact the only people who seem to have any shadow of responsibility, or to do any work, are the very busy members of Secretary Mackenzie's staff (including himself) and a handful of journalistic individuals (including myself). No one in group two is complaining, thank you.

* * *

Sir Robert Horne, the Honorary President of the Congress and the dominant figure in most of the proceedings, paid his compliments to Copper Exporters, Inc. He rather viewed with alarm, as the saying goes, the "international cartel that tends to put the British consumer at a disadvantage, particularly as regards the price which he is compelled to pay for his material" —meaning copper. A few minutes later, however, he pointed with pride (pardonable, of course) to the fact that "the control of the marketing of tin has in effect become a British monopoly." That should make it horse and horse.

* * *

Mayor Martin of Montreal made a speech of welcome. He said that there is room for 300,000,000 inhabitants in Canada and predicted that Montreal would have a population of 4,000,000 in twenty years. Or maybe he said forty years. In any event, he qualified for membership in the Rotary Club of Los Angeles, Calif.

* * *

At the informal luncheon in Ottawa, Sir Robert Horne started his speech by saying that he wouldn't make a speech, because he had already made too many speeches, and the first one alone had weighed at least ten tons. That remark, in a subtle way, helps explain why no occasion is complete without a contribution by Sir Robert.

* * *

P. M. Anderson, head of the Union Corporation in South Africa, and president of the South African Institution of Engineers, is one of the keenest-minded and most interesting men at the Congress. His company is watching the development of Canada's mineral resources closely. He is not looking for sure things, for that is not what mining means to him; but he does want to see a reasonable chance for success before he will invest. Even then his "house" will not ask the public to join a venture until after the preliminary development has demonstrated the probability of good profits. The confidence of the public is an indispensable asset.

* * *

Alpheus Williams, son of Gardner Williams, whose name is synonymous with diamond mining in South Africa, and who himself is now manager for De Beers Consolidated has his family with him. All told there are six in the party, which ought to mean the expenditure of some $15,000. To anyone but the manager of the world's greatest diamond mine this would seem a rather expensive vacation. Mr. Williams admits that his company is doing fairly well in spite of the much talked of slump in the diamond market.

* * *

One of the attractions at Toronto was a splendid exhibition by some expert canoeists. The leader remarked that, contrary to the usual impression, a canoe is perfectly safe—if you handle it right. Which inspired F. Wartenweiler, of South Africa, to add "and the same may be said of dynamite."

Houghton Entertains State Engineering Society

PLANS for the pilgrimage of the Michigan Engineering Society to the Michigan copper district, Sept. 5, 6, and 7, have been completed. The program provides for three full days of entertainment. The first day will be devoted to registration, inspection of the Michigan College of Mining and Technology at Houghton, and an evening session of addresses on mining and metallurgical subjects. Inspection of the mines, mills, and smelters of the district, golf, and an informal dance are scheduled for the second day. The last day of the conference will be taken up with a sight-seeing tour, concluding with a picnic lunch in Keweenaw County. The program for the first evening's meeting follows:

Address of welcome—James MacNaughton, president Calumet & Hecla Consolidated Copper Co.

Response—L. E. Ayres, president Michigan Engineering Society.

Address—"Mining in the Lake Superior Copper District," William H. Schacht, manager, Copper Range Consolidated Co.

Address—"Concentration and Reclamation," C. H. Benedict, superintendent of milling, Calumet & Hecla Consolidated Copper Co.

Address—"Progress in Copper Smelting," A. T. Sweet, professor of metallurgy, Michigan College of Mining and Technology.

"Color Pictures of Copper Country," John T. Reeder, Houghton.

Personal Notes

BRADLEY STOUGHTON has returned from Europe.

Colonel PERCY E. BARBOUR has returned to New York from a recreation trip in Spain, France and England.

L. D. KNIGHT, manager of the Ingersoll-Rand Company, recently spent several weeks at the Butte offices of the company.

ARTHUR NOTMAN, of New York, is making a trip around the mining camps of the Southwest, visiting Cananea, Bisbee, and Douglas.

R. W. RUSTERHOLZ, managing director of the Ingersoll-Rand (S.A.) Ltd., recently arrived in Johannesburg after his visit to London and New York.

H. I. ALTSHULER, assistant general superintendent of mines, Compania de Real del Monte y Pachuca, Pachuca, Mexico, was in Berkeley, Calif., last week.

Hon. CHARLES STEWART, Canadian Minister of Mines, has sailed for Europe to represent the Canadian government at the League of Nations Conference at Geneva.

J. O. ELTON, manager of the International Smelting Co., and TOM LYON, geologist, recently inspected operations in the company's East Tintic property, the North Lily.

STEPHEN BIRCH, president of the Kennecott Copper Corporation, spent several days in August in Salt Lake inspecting the Utah Copper Co. plants and properties.

JOHN D. RYAN, chairman of the board of the Anaconda Copper Mining Co., recently arrived in Butte and it is reported that he will remain in Montana until after Labor day.

ARTHUR L. WALKER is making a tour of the West, visiting metallurgical plants in Colorado, Utah, California, and Arizona. He expects to return to Columbia University early in September.

FRANK L. HESS, of Washington, D. C., chief engineer of the mines and metals division of the U. S. Bureau of Mines, recently completed a trip to Nevada, Colorado, and Utah mining camps.

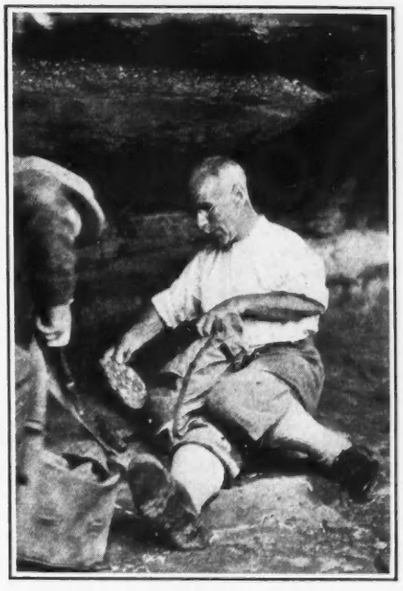
Dr. PIETRO GUARESCHI, mining engineer and metallurgist, and DR. LOUIS DELECLEAUZ, chemical engineer of Lausanne, Switzerland, recently visited the plants of the Anaconda company in Montana.

GUY H. RUGGLES, superintendent of the Inspiration mill, and HENRY ADAMS, foreman, were in Salt Lake City, attending the meeting of the American Institute of Mining and Metallurgical Engineers.

C. K. PITT has been appointed manager of Brakpan Mines and A. A. COATON, late general manager at Springs Mines, has been appointed one of the consulting engineers to the Anglo-American group.

D. MISER has been placed in charge of the section of geology of fuels of the U. S. Geological Survey. He will be succeeded as head of the Survey's section of areal and non-metalliferous geology by G. R. MANSFIELD.

DR. E. B. BAILEY, geologist, of Edinburgh, examining fossilized rock. Dr. Bailey is an assistant director of the Scottish Geological Survey. He was severely wounded during the battle



of the Somme, losing the sight of one eye. It took three bullets to stop him. He was, in fact, an 80 per cent disability, but a fine constitution brought him through. Today he tramps miles or scales mountains in pursuit of geological knowledge.

ARTHUR B. PARSONS, associate editor of the *E. & M. J.*, is taking the transcontinental trip with the Empire Mining Congress, and will return toward the end of September, through the Coeur d'Alenes, Butte, and Salt Lake City.

ALEXANDER GRANT MCGREGOR has gone to the Roan Antelope Copper Mine in Northern Rhodesia. He recently left New York and is accompanied by T. FIELD and L. R. JACKSON. Mr. Jackson will take over the management of the mine.

C. V. WHITNEY, of New York, and R. H. CHANNING, Jr., of San Francisco, representing the interests holding the option on the Flin Flon copper property, in northern Manitoba, are spending some days at the property, where extensive tests are being carried out.

Captain J. P. HODGSON, formerly manager of the Morenci Branch of the Phelps Dodge Corporation, has assumed the management of the Copper Queen Branch, at Bisbee, Ariz. Captain Hodgson has just returned from a trip to England and the Continent.

E. DE GOLYER and H. FOSTER BAIN, president and secretary, respectively, of the American Institute of Mining and Metallurgical Engineers, were guests of the North Pacific section of the Institute at Seattle, Wash., and the Seattle Mining Club at a joint meeting on Aug. 9.

LUDWIG BREITMEYER, a director of De Beers and New Jagersfontein diamond companies and chairman of the Cape Asbestos Co., Ltd., who is seventy-four years of age, is about to marry the Baroness von Wimpffen, widow of a Hungarian nobleman. The baroness is fifty-seven.

D. C. JACKLING, president of the Utah Copper Co., visited Salt Lake recently on his regular inspection of activities at Bingham, Arthur, and Magna. Colonel Jackling also visited the Nevada Consolidated Copper Co. mines and mills at Ely, Nev., and the Butte & Superior mine, at Butte.

CHARLES W. CLARK, in charge of the mining interests of former Senator W. A. Clark, of Butte, spent several days recently at Ophir, Utah, where the Clark interests have put down a three-compartment shaft 1,400 ft. to prospect on the Lion Hill side of the camp the downfaulted Ophir formations. These were productive of $26,000,000 in the Ophir Hill Consolidated.

ERNEST W. ELLIS, assistant professor of mining and metallurgy at the Idaho School of Mines, and former Idaho state commander of the American Legion, has been named chairman of the Idaho delegation to the third annual convention of the American Legion in Paris, Sept. 19 to 23. Mr. Ellis has recruited a party of forty to represent Idaho. Mrs. Ellis also will make the trip.

C. F. KELLEY, president of the Anaconda Copper Mining Co., J. R. ROBBINS, vice-president; J. CARLOS ROBBINS, L. O. EVANS, attorney, and JAMES WOODWARD, president of the Metals Bank and Trust Co. of Butte, recently visited Salt Lake to inspect operations at the International Smelting Co.'s smelter and flotation mill at Tooele, Utah, and to visit Park City, Tintic, and Bingham, where the company has large interests.

OBITUARY

THEODORE SUTRO, lawyer, publicist, author, and journalist, who reorganized the Sutro Tunnel Co. of Nevada as the Comstock Tunnel Co., for the development of the Comstock gold and silver mines, in 1887, died in New York City on Aug. 28. Mr. Sutro, who was eighty-two years old, had been prominently identified with the civic, legal, and literary life of New York for half a century.

Recent Technical Publications

Papers to Be Presented Before the Empire Mining Congress

THE following are some of the papers to be read at the British Empire Mining and Metallurgical Congress. Copies may be obtained on application to the Editor of the Congress, 623 Drummond Building, Montreal, Canada.

DEEP-LEVEL MINING AND HIGH TEMPERATURES. By A. Mavrogordato and H. Pirow. The authors of this paper are conducting an inquiry into certain cases of sudden death, presumably due to heat stroke. In the course of their paper they compare the relative cooling power of air currents, as indicated by wet Kata factors, and the paper strongly emphasizes the points made in the *E. & M. J.* editorial of Aug. 26. Particular interest attaches to the discussion of the "desirable" and "good enough" wet Kata cooling factors.

NICKEL—PAST AND PRESENT. By Robert C. Stanley. Starting from the earliest ages of man, the author of this paper reviews the whole history of nickel and the nickel industry. After dealing with the investigations of the early research workers and of the metallurgists of more modern times, Stanley reviews present-day industrial uses of nickel and the nickel alloys. His treatment of the alloys is detailed, and the paper contains a wealth of information in clearly set out tabular form relating to the commercial composition of nickel silver, structural nickel steels, copper-nickel alloys, heat-resisting and electrical alloys, nickel-steel castings, and white gold.

NOTES ON THE OPERATION OF THE REDUCTION PLANT AT WEST SPRINGS, LTD. By Carl R. Davis, J. L. Willey, and S. E. T. Ewing. This very large mill is designed to treat 50,000 tons a month, and the authors present a complete analysis of the costs of operation, dealing with various sections of the plant independently. Technical data dealing with the fine grinding, filtering, and recovery plants are incorporated in the paper.

THE SINKING AND EQUIPMENT OF THE VENTILATION SHAFT OF THE GOVERNMENT GOLD MINING AREAS MINE. By A. Job. The shaft referred to is circular in section and 22 ft. inside diameter. Its sinking is described briefly, and the author then discusses the installation of a large fan capable of a duty of 900,000 cu.ft. of air per minute, against a water gage of 7 in. Not the least interesting feature of the paper is the description of two notable accidents which occurred in the course of the sinking, one of which must surely be unique in the annals of mining.

DEWATERING THE LOWER LEVELS OF THE SIMMER AND JACK MINES. By R. Craib. This paper describes how a large body of water amounting to 500,000,000 gal. plus a daily inflow of 700,000 gal. per twenty-four hours was removed from the mine.

THE SILVER MINING INDUSTRY IN CANADA. By Arthur A. Cole. The author opens his paper by a review of Canada's position as a silver producer and then presents a brief outline of the ore occurrences, geology, and technical practice in Ontario and British Columbia.

TIPPING AND GUIDING VERTICAL SKIPS. By G. W. Sharp. The author holds that wear and tear and general condition of rope, guides, shaft timbering, winding engine, as well as the skip itself, depend so much on the manner in which it is guided and tipped that practical improvement in this connection must be reflected in working costs. The paper embodies the latest practice on the Rand and is profusely illustrated with diagrams and drawings.

A NEW FORM OF AIR METER AND THE MEASUREMENT OF COMPRESSED AIR. By E. J. Laschinger. Mr. Laschinger, finding existing types of air meters unsatisfactory for mine work, has designed a form in which a door or gate of substantial weight hangs vertically over the pipe opening in a special chamber which forms part of the pipe line. Below the lower horizontal lip of the gate is a brass shield, fairly close to the lip when the gate is shut, but progressively further away as the gate opens further owing to increasing flow of air. The result of this arrangement is to make the gate's angular movement, which is transferred to the recording mechanism, correspond to the rate of flow, so that equal increments of angular movement represent equal amounts of flow.

PRECIOUS METALS IN THE SUDBURY ORES AND THEIR RECOVERY. By C. Langer and C. Johnson. The metallurgical methods adopted for the recovery of gold, silver and platinum group metals from anode sludge and residues of the nickel carbonyl process are described by the authors. The paper also contains a brief outline of the carbonyl process as used for the recovery of nickel from Ontario mattes at Clydach, South Wales.

METHODS OF ELIMINATING BARREN ROCK FROM ORE AT THE SUB NIGEL MINE, TRANSVAAL. By W. A. Quince. This is a short description of the various methods in use at the mine for bringing up the grade of the ore sent to the mill. Resuing is used extensively, both in development and stoping. Stoping widths as narrow as 16 in. are in force, involving a distinct problem in handling the broken ore. The sorting methods adopted, both underground and at surface, are also discussed.

BASE-METAL AND BASE-MINERAL RESOURCES OF THE UNION OF SOUTH AFRICA. By C. J. N. Jourdan. The extent and importance of the gold-mining industry of the Witwatersrand have tended to eclipse the other mining activities of the Union. In this paper the author gives a brief review of the extensive South African base-metal and coal-mining industries.

OUTLINE OF MINING AND METALLURGICAL PRACTICE IN AUSTRALASIA. VOL. 1. Prepared by leading authorities in collaboration. Parts I and II of this paper are devoted to coal and iron. Under the heading "Gold" a brief outline is given of the transition in mining and metallurgical practice at Mount Morgan. In Part IV, which deals with lead and zinc, the more recent developments in mining and metallurgical methods at Broken Hill, the Read-Rosebery Mines of the Electrolytic Zinc Co., and the lead smelters at Port Pirie are discussed. The collaborating authors give an interesting description of the methods adopted to recover the ground lost in the extensive cave which occurred in the Broken Hill property in February, 1925. The account of the flotation practice at the Read-Rosebery mines is a further valuable contribution to the available literature on this subject. A concluding section of the paper is devoted to copper and contains the latest information on present-day practice at Mount Lyell.

IMPROVEMENTS OF DRILLING EFFICIENCIES WITH JACKHAMMERS. By P. M. Newhall and L. Pryce. The investigations which form the basis of this very interesting paper are a part of the systematic studies carried out during the last four years on behalf of the Central Mining-Rand Mines group. After comparing the relative efficiencies of wet and dry drilling, the authors proceed to deal exhaustively with the question of gage of bits and their heat treatment. The question of air pressures receives attention and a rock-drill testing machine is described.

RECENT PATENTS

SCREEN GRATE FOR BALL MILLS. No. 1,637,986. Aug. 2, 1927. William Currie, assignor to Chrome Steel Works, Carteret, N. J.

A ball-mill grate segment consisting of a series of forged hard steel grate bars.

ORE CONCENTRATOR. No. 1,638,864. Aug. 16, 1927. Kennedy Monthferd Mathe and John Monthferd Mathe, Hammond, Ind.

Design for a pan having a combined rocking and circular motion.

The Market Report

Another Quiet Week in Metals But Copper Picks Up

New York, Aug. 31, 1927 — Copper has sold in much better volume than for several weeks, and prices have taken a turn for the better; other metals, however, have been quiet, with lower prices for lead and tin. Zinc has had an unusually quiet market, but prices have held, as have those for silver. Industrial conditions promise to be active in the fall, even if not on quite the scale of a year ago, and the coming month should witness an improvement in the volume of metals sold over that for August, particularly for copper.

Copper Sold for 13¼c. Again

The tone of the copper market is perceptibly better. Again in the week ending today, as in the two previous weeks, most of the large sellers have refused to quote below 13¼c., delivered to usual Connecticut points, though business has been taken in certain directions as low as 13.05c. In fact, resale lots of spot copper have been sold in the New York district for as low as 12.95c. cash. However, the cheaper offerings have been less in evidence in the last three days; yesterday and today it was difficult to find anything under 13.20c., delivered Connecticut, and as early as Monday some sellers got the full 13¼c. price. Today there has been a slight though apparently temporary weakness. The foreign demand, at the present Exporters' price of 13½c., c.i.f., has also improved a great deal during the week, though not yet quite up to the recent average.

Every indication points to the fact that the majority of October copper remains to be bought, and that some buyers have yet to make provision for the last half of September. A good buying movement may well be expected therefore, within the next week or two, with the vacation season over.

Lead Still Shows a Downward Trend

The week's trading opened very feebly and consumers showed little or no interest: small lots were sold at prices ranging from 6.15 to 6.175c. per lb. f.o.b. St. Louis. The total volume of business was, if anything, even smaller than in the previous week, and buyers had to be persuaded by lowered prices to enter the market. Monday witnessed increased activity, with consequently slight stiffening in prices asked. There seems little doubt that more lead is available than can readily be absorbed and the statistical position of the metal is not considered over-sound, though at least two producers are temporarily practically out of the market. On Aug. 30 the American

Daily Prices of Metals

Aug.	Copper	Tin		Lead		Zinc
	Electrolytic, N. Y.	99 Per Cent	Straits	N. Y.	St. L.	St. L.
25	12.825@12.85	62.875	63.875	6.55@6.60	6.15@6.175	6.25
26	12.825@12.95	62.50	63.625	6.55@6.60	6.20	6.225–6.275
27	12.95	62.625	63.75	6.55@6.60	6.20	6.225@6.25
29	12.925@13.025	62.75	63.75	6.55@6.60	6.20	6.275@6.30
30	13.00@13.025	62.625	63.50	6.50@6.60	6.15@6.175	6.275
31	12.925@12.975	62.75	63.625	6.50	6.125	6.275
	12.935	62.688	63.688	6.558	6.175	6.263

Average prices for calendar week ending Aug. 27, 1927, are: Copper 12.877; 99 per cent tin, 62.750; Straits, 63.854; N. Y. lead, 6.604; St. Louis lead, 6.223; zinc, 6.275; and silver, 54.417.

The above quotations are our appraisal of the major markets for domestic consumption based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

Copper, lead, and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

In the trade, copper prices usually are quoted on a delivered basis; i.e., delivered at consumer's plant. As delivery and interest charges vary with the destination, the figures shown above are net prices at refineries on the Atlantic seaboard. Delivered prices in New England average 0.225c. per pound above those quoted, and prices at so-called Middle West destinations, 0.325c. above.

Quotations for copper are for ordinary forms of wire bars, ingot bars, and cakes. For ingots an extra 0.05c. per pound is charged and there the other extras for other shapes. Cathodes are sold at a discount of 0.125c. per pound.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York is now quoted at 0.35c. per pound above St. Louis, this being the freight rate between the two points.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

London

Aug.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
25	54½	54⅞	61¾	290	285¼	22⅝	23	27⅜	27½
26	54⅝	54 15/16	61¾	287½	283⅝	22⅜	22¾	27 9/16	27 5/16
29	55 1/16	55⅜	62	289½	285¼	22 11/16	23⅛	27¼	27 11/16
30	55 3/16	55⅝	62	289⅛	285	22½	22⅞	27 15/16	27 11/16
31	54 15/16	55 7/16	62	289½	286	22 7/16	22⅞	27 11/16	27 9/16

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

Aug.	Sterling Exchange "Checks"	Silver		Gold London	Aug.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
25	4.85 5/8	54½	25⅛	84s11½d	29	4.85¾	54¾	25⅛	84s11½d
26	4.85¾	54⅝	25⅛	84s11½d	30	4.85¾	54⅞	25¼	84s10½d
27	4.85¾	54½	25 3/16	.....	31	4.85¾	54½	25 3/16	84s10¾d
					Avg.		54.625		

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-half cent premium.

Average Metal Prices for August, 1927

COPPER:	
New York Electrolytic	12.971
London Standard Spot	55.364
London Electrolytic Spot	62.227
LEAD:	
New York	6.681
St. Louis	6.367
London Spot	23.119
London Forward	23.540
SILVER:	
New York	54.718
London	25.224
Sterling Exchange	485.546
ZINC:	
St. Louis	6.342
London Spot	28.210
London Forward	28.068
TIN:	
99 per cent	63.523
Straits	64.431
London	29.319
QUICKSILVER	119.111
ANTIMONY	11.826
PLATINUM:	
Refined	72.000
Crude	62.000
ALUMINUM, 98 PER CENT	26.000

Smelting & Refining Co. again reduced its contract price: it will be remembered that this was fixed at 6.60c. on August 24. The present reduction brings the price down to 6.50c. New York. Corroding grades command a premium of $2@$3 per ton over common lead.

Zinc Neglected at 6.275c.

This has been the quietest week of the summer for zinc, practically no sellers doing their normal volume of business. The price has fluctuated between 6.225 and 6.30c., St. Louis, with 6.275c. ruling the last two days. Most of the sales were made on Thursday and Friday, the market since then being almost entirely lifeless. Nearly all inquiries have been for prompt metal. Small lots of high-grade zinc for prompt shipment continue nominal at 8c., delivered at Eastern points. New York prices on Prime Western continue at the usual premium of 35c. per 100 lb. over those in St. Louis.

Tin Steady

Only small fluctuations in the price of tin have occurred during the week. No forecast of this market can be made very reliably, since so much depends on operations carried on on the London Metal Exchange. Identical prices obtain for spot, September, and October tin, and there is a small premium amounting to one-quarter of a cent on November and half a cent on December deliveries.

Foreign Exchanges Steady

Closing cable quotations on Tuesday, Aug. 30, were as follows: francs, 3.92⅛c.; lire, 5.43⅞c., and marks, 23.80c. Canadian dollars, par.

Silver Firm at 54½c.

During the last week the silver market has been steady to firm, the New York quotation reaching 54⅞c. on Tuesday, Aug. 30th, which was on account of good buying orders from India and China. Today, however, the market has an easier undertone, which is apparently the reflection of sales for China account and lack of buying orders from India.

Mexican Dollars (Old Mexican pesos): Aug. 25th, 41c.; 26th, 41¼c.; 27th, 41c.; 29th, 41¼c.; 30th, 41⅜c.; 31st, 41c.

Lower Prices for Zinc and Lead Ore

Joplin, Mo., Aug. 27, 1927

Blende

		Per Ton
High		$45.20
Premium blende, basis 60 per cent zinc	$43.00@	45.00
Prime Western, basis 60 per cent zinc	42.00@	43.00
Fines and slimes, 60 per cent zinc	39.00@	41.00
Average settling price, all zinc		41.46

Galena

High		$90.40
Basis 80 per cent lead	$85.00@	90.00
Average settling price, all lead		87.59

Shipments for the week: Blende, 16,434; lead, 5,087 tons. Value, all ores the week, $1,126,910.

Shipments for eight months: Blende, 433,876; lead, 68,485 tons. Value, all ores eight months, $24,418,130.

Several transactions in lead ore early this week were on a basis of $90 per ton, the price offerings declining today to $85 basis. More lead ore was reported shipped this week than in any two previous weeks this year.

Blende prices were generally lowered, as very little Prime Western brought the $43 basis, and only one lot of premium brought the $45 basis, the bulk of the sales being made on $42 Prime Western and $43 to $44 for premium. Purchase this week, 13,340 tons.

Zinc shipments for this year are 120,665 tons less than last year, and lead shipments are 13,440 tons less.

Empire Zinc, out of the market for two years, purchased a small tonnage this week.

Platteville, Wis., Aug., 27, 1927

Zinc Blende	Per Ton
Blende, basis 60 per cent zinc	$44.75

Lead Ore	
Lead, basis 80 per cent lead	$87.50

Shipments for the week: Blende, 1,170 tons; lead, 120 tons. Shipment for the year: Blende, 44,023 tons; lead, 1,210 tons. Shipments for the week to separating plants, 2,164 tons blende.

Iron, Steel, and Coke Dull

Pittsburgh, Aug. 30, 1927

Steel bookings in August were distinctly below those of July, but the defection was smaller toward the end than in the fore part of the month. Production and shipments ran approximately the same in the two months, with an operating rate averaging slightly under 70 per cent of capacity. Production is not expected to increase materially this month, but heavier buying is expected soon, promising greater production in October.

Finished-steel prices are holding, in general, but not with any remarkable degree of firmness. A decline of $2 a ton in bars, shapes, and plates in the Chicago market is now reported as having occurred about the middle of August. The new sheet prices, though held rather generally, are being shaded occasionally.

Pig Iron—The Valley market remains dull but steady at $18.50 for bessemer, $17.25 for basic and $17.50 for foundry.

Connellsville Coke—The spot market is dull and is merely steady at $3@$3.25 for furnace and $4@$4.75 for foundry.

Other Metals

Quotations cover large wholesale lots, f.o.b. New York, unless otherwise specified. London prices are according to latest mail advices.

ALUMINUM—Per lb., 99 and 98 per cent grades, price of leading interest, 26c.; outside market, 25.30@25.80c.

[1]Price furnished by Foote Mineral Co., Philadelphia.

Consumption steady. London, 98 per cent, £104@£112 per long ton for domestic consumption.

ANTIMONY—Per lb., duty paid, spot: Chinese brands, range for the week 11¾@11⅞c.; October arrival ⅛c. higher. Market quiet. Cookson's "C" grade, spot, 17¾c.

Chinese needle, lump, 8c. Standard powdered needle, 200 mesh, 11c. White oxide, Chinese, 99 per cent Sb_2O_3, 15½c. Nominal.

BISMUTH—Per lb., in ton lots, $1.85@$2.10. London, 8s. Domestic market continues below London parity.

CADMIUM—Per lb., 60c. London, 1s. 10d. for Australian metal.

COBALT—Per lb., f.o.b. Canadian works: Shot, 96@98 per cent, $2.50. Black oxide, 70 per cent, $2.10. London, 8s. 6d.@10s. for metal; 8s. for black oxide; 8s. 10d. for gray.

[1]GERMANIUM OXIDE—Per gm. in 300- to 500-gm. lots, $5.

IRIDIUM—Per oz., $107@$110 for 98 @99 per cent sponge and powder. $115 for pure metal. London, £32½ in iridio-platinum; £20@25 for pure metal.

[1]LITHIUM—Per lb., 95@96 per cent grade in 1- to 5-lb. lots, $65.

MAGNESIUM—Per lb., in ton lots: 8-lb. ingots (3x3x15 in.), 95c.; 3-lb. sticks (1⅜x33 in.), $1.00; 10-oz. sticks (1x12 in.), 90c. Market firm. London, 3s. 9d.@4s. 3d. for 99 per cent ingots or sticks.

[1]MOLYBDENUM—Per kg., 99 per cent, $25; chemically pure metal, $80.

MONEL METAL—Per lb. base price for shot, 28c.

NICKEL—Per lb., ingot, 35c.; shot, 36c.; electrolytic, 39c. (99.75 per cent grade), for single lots of spot metal. London, per long ton £170@£175 according to quantity. Demand continues good.

OSMIUM—Per oz., $60@$65; fair demand. London, £11@£13.

PALLADIUM—Per oz., $53@$55. Small lots bring up to $58. Pure metal as a constituent of crude platinum, nominal London, £12½@£9½. Nominal.

PLATINUM—Official price quoted by the leading interest on small miscellaneous orders for refined metal, per oz., $72. Dealers and refiners quote the trade for refined metal, per oz., $64.50@$66, cash. Market slightly more active. Sponge, 99.5 per cent pure, per oz., cash, $63. Pure metal as a constituent of crude platinum, nominal at $62. Continues very dull.

London, per oz., £13⅝@£14 for refined; crude and scrap, nominal.

QUICKSILVER—Per 76-lb. flask, range for the week $118½@$119½. San Francisco wires $120.67. London firm at £21⅞@£22.

RADIUM — Per mg. radium content, $70.

RHODIUM—Per oz., $55@$58; London, £8@£11½. Nominal.

RUTHENIUM—Per oz., $40. Nominal. London £6@£8½.

[1]SELENIUM—Per lb. in ton lots; Black, powdered, amorphous, 99.5 per cent pure. $1.90@$2. London, 7s. 6d. @7s. 8d.

TANTALUM—Per kg.: Bar and heavy sheet, chemically pure, $200. Firm.

TELLURIUM—Per lb., $2.

[1]THALLIUM METAL—Per lb.: Ingot, 99 per cent pure, $12 in 25-lb. lots.

TUNGSTEN POWDER—Per lb., 97 to 98 per cent pure, $0.97@$1 per lb. contained W.

[1]ZIRCONIUM METAL—Per lb., 98 per cent grade, $15 in 5- to 10-lb. lots.

Metallic Ores

CHROME ORE—Per long ton, f.o.b. Eastern shipping points, $22.50@$23.50 for 45 to 50 per cent Cr_2O_3 ore. Prices firm.

IRON ORE—Per long ton, lower Lake ports. Lake Superior ores.

Mesabi, non-bessemer, 51½ per cent iron, $4.25. Old Range, $4.40.

Mesabi, bessemer, 51½ per cent iron, $4.40. Old Range bessemer, 51½ per cent, $4.55.

Eastern ores, cents per unit, delivered at furnaces: Foundry and basic, 53 to 63 per cent, 9@10½c.

Foreign ores, f.o.b. cars Atlantic ports, cents per unit.

Swedish and Norwegian, low-phosphorus, 68 per cent, 10½@10¾c.

North African, low-phosphorus, 10½@11½c.

Spanish foundry or basic, 50@54 per cent, 9@9½c. Nominal.

Swedish foundry or basic, 66@68 per cent, 9@9½c.

MANGANESE ORE—Per long ton unit of Mn, c.i.f. North Atlantic ports, minimum 47 per cent Mn, 36@38c. Caucasian (washed), 53@55 per cent, 40c.

Per ton in carload lots:

[1]Chemical grades, powdered, coarse or fine, 82@87 per cent MnO_2, Brazilian and Cuban, $70@$80.

MOLYBDENUM ORE—Per lb. of MoS_2, for 85 per cent MoS_2 concentrates f.o.b. Denver, Colorado, 50c.

TANTALUM ORE—Per unit of Ta_2O_5, basis 65 per cent ore, $10@$14.

TITANIUM ORE—Ilmenite, per gross ton, 52 to 60 per cent TiO_2, f.o.b. Atlantic seaboard, $10@$15, according to grade and impurities. Low-grade domestic, 32 to 35 per cent, about $7@$8 per gross ton. Rutile, per lb., 96 per cent concentrate, 11c. to 13c.

TUNGSTEN ORE—Per unit of WO_3, N. Y.: Wolframite, $10.10@$10.25, Western scheelite, $10.50@$10.75. Market dull, prices largely nominal.

URANIUM ORE—Per lb. of U_3O_8 contained: (Minimum 5 per cent U_3O_8), nominal at $5, f.o.b. Montrose, Colo.

VANADIUM ORE—Per lb. V_2O_5: Containing 5 per cent V_2O_5, nominal at 25c., f.o.b. Montrose, Colo.

Foreign concentrate (lead vanadate) 12 to 18 per cent V_2O_5, 55@60c., duty paid, seaboard. Nominal.

Non-Metallic Minerals

Prices received for non-metallic minerals vary widely and depend upon the physical and chemical characteristics of the commodity. Hence the following quotations can serve only as a general guide to the prices obtained by producers and dealers in different parts of the United States for their own product. In the last analysis the value of a particular non-metallic mineral can be ascertained only by direct negotiation between buyer and seller.

[1]AMBLYGONITE—Per ton, f.o.b. mines: 8@9 per cent lithium oxide, $50@$60.

ASBESTOS—Per ton: f.o.b. Quebec mines, tax and bags included, prices quoted by leading interest.

Crude No. 1, $575; crude No. 2, $375; spinning fibers, $225; magnesia and compressed sheet fibers, $150@$200; shingle stock, $60@$125 various grades; paper stock, $40@$50; cement stock, $25; short fibers, $10@$20; floats, $15. Market fairly active for all grades above paper stock. Higher prices forecast for 1928 delivery on all of the better grades.

Per ton c.i.f. New York: Rhodesian crude No. 1, $425; No. 2, $325@$350.

BARYTES—Per long ton: f.o.b. mines, bags extra:

Georgia: Barytes ore, crude, $7. Wet ground, off color, $12@$18, depending on analysis. Market poor.

Missouri: Water ground and floated, bleached, $23; $25 in less than car lots, f.o.b. works. Crude ore, 93 per cent $BaSO_4$, not to exceed 1 per cent iron, per ton, $8, f.o.b. mines. Market fair.

BAUXITE — Per long ton: No. 1 chemical ore, over 60 per cent Al_2O_3, less than 5 per cent SiO_2, and less than 2 per cent Fe_2O_3 $8, f.o.b. *Georgia* mines. Somewhat firmer but little demand.

Per metric ton foreign, c.i.f.: Dalmatian, low SiO_2, $5@$6.50; Istrian, $5.50@$7; French, red, $6@$7.50.

BORAX—Per lb.: Carload lots, in bags, crystals, 4¼c.; granulated or powdered, 4c.; f.o.b. plant, Pennsylvania. Market slow.

[1]CELESTITE—Per ton in carload lots: 90 per cent $SrSO_4$, finely powdered, $27.

CHALK—Per ton: Crude in bulk, c.i.f. *New York*, $4.75@$5.

CHINA CLAY (KAOLIN)—Per ton: F.o.b. *Virginia* mines, crude lump, No. 1, $7; crude No. 2, $5.50; washed, $8; powdered and air-floated, $10@$15; ground, $7@$10.

Florida, pressed pottery, bulk, $13; ground, No. 1, $20; No. 2, $15. Sprayed mineral flour No. 1, $20; No. 2, $17.

Best grade, domestic, $16@$18, f.o.b. *Delaware* plants in carload lots. Seasonal slowness.

Imported English, f.o.b. American ports: Lump, $13@$21; powdered, $45@$50.

DIATOMITE — Per short ton, f.o.b. plant:

Kiln-fired brick, $65; kiln-fired aggregate, ¼ in., $45; insulating powder, $30; natural aggregate, ¼ in. $20; air-floated powder, $40. Over 85 per cent silica, 98 per cent through 200 mesh, $15@$16, depending on quantity. Market fair.

EMERY — F.o.b. *Pennsylvania* and *New York* in 350-lb. kegs, per lb.: Greek Naxos, 6½c.; Turkish, 6½c.; Khasia, 5½c.; domestic, 3½c. Market good.

FELDSPAR—F.o.b. mine or grinding plant:

North Carolina, per long ton: No. 1 pottery grade, $5.50@$7. Market good.

New Hampshire, per ton: Pottery grade, $8.50. Best quality lump, $9. Market good.

New York: Per ton, f.o.b. cars, No. 1 crude, $9. Market fair.

Tennessee, per ton: No. 1, pottery, 140 mesh, $16; 200 mesh, $18. No. 2, enamel, 140 mesh, $13.50; 200 mesh, $15; increased demand.

Maine, per ton: Best pottery grade, ground, $19. Market slow.

FLUORSPAR—Per ton: F.o.b. *Kentucky* and *Illinois* mines.

Gravel, not less than 85 per cent CaF_2, and not over 5 per cent SiO_2, $17@$18. Quiet. Foundry lump, 85-5, $20. Ground, 95 to 98 per cent CaF_2, and not over 2½ per cent SiO_2, $32.50 in bulk; $36.50 in bags or barrels. Acid lump, 98-1, $30 in car lots. Market somewhat unsettled. Demand subnormal.

New Mexico: 85-5 gravel, $16.50; 85-5 lump, $16; 90-4 lump, $19; 96-3 ground 100 mesh, $40, bulk. Market fairly good.

Foreign spar, duty paid, $15.75@$16.50, tidewater. Prices easier.

FULLERS EARTH — Per ton, f.o.b. *Florida:* 16 to 30 mesh, $16.50; 30 to 60 mesh, $18; 60 to 100 mesh, $15; 100 mesh up, $8; 200 mesh up, $15. Market fair at unchanged prices.

Powdered, import duty paid, $24@$25 per ton.

GARNET — Per ton; domestic, f.o.b. mines, $85. Market easy.

Spanish grades, $60, c.i.f. port of entry.

GILSONITE — Per ton, carload lots, f.o.b. mines *Colorado:*

Selected grade, $33; seconds (mine run), $22.50.

GRAPHITE — Per ton: F.o.b. *New York.*

Ceylon lump, 7½@8c.; chip, 6½@7c.; dust, 3@5c.; Magdagascar flake, 6½c. Market quiet.

No. 1 flake, 10c.; fine flake, 7c. Foundry facings, 4c. Amorphous, fine ground, 3c.; fine ground crystalline, 5c. Crude amorphous graphite, $15@$35 per ton, according to grade. Slightly improved market.

GREENSAND—Per ton, f.o.b. cars, *New Jersey:* Screened and bagged, best grade in carload lots, $25. More inquiries indicate good fall business.

GYPSUM—Per ton, f.o.b. mill, depending upon location: Crushed, $2.75@$3; ground, $4@$10; agricultural, $6@$15; calcined, $8@$10.

IRON OXIDE (See Ocher)—Per lb.: Standard Spanish red, 2½@4½c.; domestic earth, 2@4½c.

KAOLIN—See China Clay.

[1]Price furnished by Foote Mineral Co., Philadelphia.

[1]LEPIDOLITE—Per ton: $20@$30 for ordinary grades. Nominal.

LIMESTONE—Per ton: f.o.b. shipping points, depending on location, either lump or crushed, 75c.@$2.

Agricultural, 75c. up to $4 or $5 for crushed or pulverized. Prices depend upon source, purity, and fineness.

MAGNESITE — Per short ton, f.o.b. *California* mines: Grade "A" calcined, 80 per cent through 200 mesh, $40; grade B, $38; dead burned, $33; crude, $14. F.o.b. Eastern seaboard, calcined, $40. Market fair.

MICA—Per ton, f. o.b. plant:

New Hampshire: Mine run, $300; clean shop scrap, $25; mine scrap, $22. White dry ground, 20 mesh, $25; 40 mesh, $35; 60 mesh, $65; 100 mesh, $75; 200 mesh, $85. Market more active.

North Carolina: White, ground, 20 mesh, $35; 70 mesh, $100.

Madagascar, amber, dark, free from iron, per lb., f.o.b. *New York*, duty paid: Special, $3.50@$4. No. A1, $3@$3.50; No. 1, $3; No. 2, $2.50@$2.75; No. 3, $1.25@$1.30; No. 4, 70@80c.; No. 5, 45@55c. No arrivals expected for several months. Market strong.

[1]MONAZITE—Per ton: (Minimum 6 per cent ThO_2), $120.

OCHER — F.o.b. *Georgia* mines, per ton: $22.50@$25 in sacks; $25@$30 in barrels; washed and water floated, $22@$25; second grade, 99 per cent through 225 mesh, $18. Market fair.

PHOSPHATE—Per long ton, f.a.s. or f.o.b. mines:

Florida, pebble, f.a.s., for export: 76@77 per cent, $7; 75 per cent, $6.25; 74@75 per cent, $6; 70 per cent, $4.50; 68 per cent, $4.10; 66 per cent, $4. Prices firm; market active.

Florida, pebble, domestic: 76@77 per cent, $6; 75 per cent, $5.25; 74@75 per cent, $5; 72 per cent, $4; 70 per cent, $3.50.

Tennessee, ground, 97 per cent through 200 mesh, 33 per cent P_2O_5, $9.50 per ton. Active shipping season has started and farmers in Illinois are more active buyers than last year. Brown lump for acid manufacture, per gross ton, $5.50 on 75 per cent basis; $4.50 for 72 per cent basis.

POTASH—The ruling contract prices are as follows:

	Bags	Bulk
Muriate of potash 80 @ 85 per cent, basis 80 per cent....	36.40	34.80
Sulphate of potash 90 @95 per cent, basis 90 per cent....	47.30	45.70
Sulphate of potash-magnesia 48 @ 53 per cent, basis 48 per cent	27.25	25.65
Manure salt 30 per cent.....	21.75	18.75
Manure salt 20 per cent.....	15.40	12.40
Kainit 14 @ 16 per cent....	12.50	9.50
Kainit 12.4 per cent.....	12.00	9.00

Two thousand pounds net weight, c.i.f. Atlantic and Gulf ports. German weights, tares and analyses.

Discounts: 5 per cent on minimum of 50 tons K_2O; 6 per cent on 100 tons; 7 per cent on 300 tons; 10 per cent on 500 tons.

PUMICE STONE—Per lb.: In barrels, powdered, 2½@4c.; selected lump, 5@7c.

PYRITES—Per long ton unit of sulphur: Tharsis, c.i.f. U. S. ports; guaranteed 48 per cent sulphur, furnace size, 2½-in. diameter, 14c. Same price for fines screened through ½-in. mesh. Cinder from ore to remain property of buyers. Market improving.

[1]QUARTZ ROCK CRYSTALS—Per lb. in ton lots: Colorless, clear and flawed, pieces ¼ to ½ lb. in weight, 40c. For optical purposes, double above prices; larger crystals still higher.

SILICA—Per ton: Water ground and floated, in bags, f.o.b. Illinois; 400 mesh, $31; 350 mesh, $26; 250 mesh, $18. Market fair. Glass sand, f.o.b. producing plant, 75c.@$5 per ton; molding sand, 65c.@$3.50; blast sand, $1.35@$3.50.

[1]SPODUMENE — Per ton: $20@$30, depending upon lithium content. Nominal.

SULPHUR—Per ton for domestic market: $18, f.o.b. Texas mines; $22 for export, Atlantic ports. Prices in reality are on a c.i.f. basis, but the average price reduced to an f.a.s. figure is about as given. Good shipment against contracts. Open prices $1 higher than above.

TALC—Per ton, carload lots, f.o.b. works, containers included:

Vermont: 99 per cent through 200 mesh, extra white, $10.50; 96 per cent through 200 mesh, medium white, $9.50; packed in 50-lb. paper bags. Competition active.

New York: Double air-floated, 200 mesh, $13.75; 325 mesh, $14.75. Demand fair.

Georgia: Powdered, gray, $7.50@$10; yellow, $9@$12; red, $11@$13; roofing, $7.50@$9. Market fair.

New Jersey: Soapstone, ground, $10@$12; market good.

TRIPOLI—Per short ton, burlap bags, paper liners, minimum carload 30 tons, f.o.b. *Missouri:* Once ground through 40 mesh; rose and cream colored, $14. Double ground through 110 mesh; rose and cream, $17. Air-floated through 200 mesh, rose and cream, $25; mill run, $15. Business very slow, due to unusual activity during previous months.

[1]ZIRCON—Per lb., f.o.b. mines in carload lots: 95 per cent, 3c.

Mineral Products

ARSENIOUS OXIDE (White arsenic)—Per lb. 4c. Fair buying. London, per lb., 17@£17½ for Cornish white.

CALCIUM MOLYBDATE — Per lb. of contained Mo, $1.20, delivered.

COPPER SULPHATE (Blue Vitriol)—Per lb. in car lots, 5@5.10c., for either large or small crystals.

SODIUM NITRATE—Per 100 lb.; crude, ex vessel, Atlantic ports, $2.25@$2.30 for spot; future delivery, $2.27@$2.32.

SODIUM SULPHATE (Salt Cake)—Per ton, bulk, f.o.b. works, $18@$20.

[1]Price furnished by Foote Mineral Co., Philadelphia.

ZINC OXIDE—Per lb. in bags, in car lots: Lead-free, 6½c.; 10, 20 or 35 per cent leaded grades, 6⅝c.; French red seal, in bags, 9⅜c.

Ferro-Alloys

[1]FERROCERIUM—Per lb., $5.50.

FERROCHROME—Per lb. of contained chromium, 60@70 per cent chromium, 4 to 6 per cent carbon, 11@11½c.

FERROMANGANESE — Per gross ton furnace: Domestic and foreign, 78@82 per cent, $90, for delivery during second half of 1927. Spiegeleisen, 19@21 per cent, $33@$35 on carload business, f.o.b. furnace; 16@19 per cent, $32. Market dull; but prices remain steady with no tendency to change.

FERROMOLYBDENUM—Per lb. of Mo, f.o.b. shipping point, 50@60 per cent Mo, $1.25@$1.45. Business good.

FERROPHOSPHORUS—Per ton, 18 per cent P, $91; electrolytic, 24 per cent, $122.50; f.o.b. *Alabama* and *Tennessee*.

FERROSILICON—Per gross ton, f.o.b. works, freight allowed on carload lots east of Mississippi River: 50 per cent, $85; 75 per cent, $135@$145; 14@16 per cent, $45. Active market. Spot prices for small lots slightly higher.

FERROTITANIUM—Per ton: For 15 to 18 per cent material, $200, f.o.b. Niagara Falls, N. Y.

FERROTUNGSTEN—Per lb. of W contained, 75@80 per cent W, 96@98c., f.o.b. works. Quiet.

FERROVANADIUM—Per lb. of V contained, f.o.b. works, $3.15@$3.55, depending on grade. Market good.

Metal Products

ROLLED COPPER—Sheets, 22c.; wire, 15@15¼c. per lb., f.o.b. mill.

LEAD SHEETS—Full rolled, 10¼c. per lb.; clipped, 10½c. Prices quoted last week were erroneous. No change during month.

NICKEL SILVER—28¾c. per lb. for 18 per cent nickel Grade A sheets.

YELLOW (MUNTZ) METAL—Dimension sheets, 19¼c. per lb.; rods, 16¼c. per lb.

ZINC SHEETS—10c. per lb., f.o.b. works. Price increased from 9¾c. on Aug. 2.

Refractories

CHROME BRICK—Per net ton, f.o.b. shipping point, $45.

FIRECLAY BRICK — Per M.: First quality, $43, *Ohio, Kentucky, Central Pennsylvania;* second quality, $35.

MAGNESITE BRICK—Per net ton, f.o.b. works: 9-in. straights, $65.

SILICA BRICK—Per M., *Pennsylvania* and *Ohio*, $43; *Alabama*, $51; *Illinois*, $50@$52.

[1]ZIRKITE—Per lb.: Powdered, 80 per cent ZrO_2, 3c. Brick, straights, 80c.@$1 each.

Metal Statistics

Monthly Average Prices of Metals

Silver

	New York		London Spot		Sterling Exchange	
	1926	1927	1926	1927	1926	1927
anuary	67.795	55.795	31.322	25.863	485.295	484.775
February	66.773	57.898	30.797	26.854	485.852	484.551
March	65.880	55.306	30.299	25.655	485.606	484.887
April	64.409	56.399	29.682	26.136	485.702	485.178
May	65.075	56.280	30.125	26.072	485.485	485.288
June	65.481	56.769	30.248	26.203	486.000	485.183
July	64.793	56.360	29.861	25.983	485.755	485.145
August	62.380	54.718	28.773	25.224	485.293	485.546
September	60.580	.....	27.904	.....	484.845	.....
October	54.505	.....	25.291	.....	484.475	.....
November	54.141	.....	25.192	.....	484.359	.....
December	53.466	.....	24.733	.....	484.553	.....
Year	62.107	.....	28.686	.....	485.268	.....

New York quotations, cents per ounce troy, 999 fine. London, pence per ounce, sterling silver. 925 fine.

Copper

	New York		London Spot			
	Electrolytic		Standard		Electrolytic	
	1926	1927	1926	1927	1926	1927
January	13.822	12.990	59.013	55.414	65.325	62.375
February	13.999	12.682	59.669	54.438	66.375	61.119
March	13.859	13.079	58.603	55.935	65.489	62.641
April	13.706	12.808	57.200	55.056	64.600	61.526
May	13.599	12.621	56.494	54.563	64.313	60.881
June	13.656	12.370	56.778	54.030	64.591	59.881
July	13.924	12.532	57.864	54.551	65.625	60.089
August	14.174	12.971	58.857	55.364	66.857	62.227
September	14.062	.....	58.705	.....	66.528	.....
October	13.862	.....	58.304	.....	66.298	.....
November	13.576	.....	57.293	.....	65.551	.....
December	13.302	.....	56.869	.....	64.114	.....
Year	13.795	.....	57.971	.....	65.472	.....

New York quotations, cents per pound. London, pounds sterling per long ton

Lead

	New York		St. Louis		London			
	1926	1927	1926	1927	1926 Spot	1926 3 Mos.	1927 Spot	1927 3 Mos.
January	9.255	7.577	9.102	7.392	34.778	34.584	27.485	27.786
February	9.154	7.420	8.991	7.286	33.903	33.903	27.344	27.781
March	8.386	7.577	8.165	7.328	31.625	31.921	27.845	28.302
April	7.971	7.126	7.764	6.807	28.775	29.284	26.546	27.053
May	7.751	6.616	7.538	6.269	28.253	28.719	25.054	25.526
June	8.033	6.414	7.876	6.150	29.986	30.142	24.438	24.750
July	8.499	6.344	8.383	6.120	31.716	31.545	23.491	23.932
August	8.908	6.681	8.722	6.367	32.756	32.345	23.119	23.540
September	8.786	.....	8.515	.....	32.085	31.790	.....	.....
October	8.402	.....	8.130	.....	30.821	30.696	.....	.....
November	8.005	.....	7.800	.....	29.270	29.563	.....	.....
December	7.855	.....	7.688	.....	28.932	29.264	.....	.....
Year	8.417	.....	8.223	.....	31.075	31.146	.....	.....

New York and St. Louis quotations, cents per pound. London, pounds sterling per long ton.

Tin

	New York		London			
	1926	1927	1926	1927	1926	1927
	99%		Straits		Spot	
January	61.415	64.785	62.275	66.415	282.038	297.804
February	62.653	66.528	63.705	69.142	287.107	306.125
March	63.472	67.833	64.505	69.199	292.288	313.315
April	61.962	66.069	63.389	67.933	281.388	302.572
May	60.165	63.935	62.305	67.510	270.125	294.938
June	58.409	64.226	60.611	67.466	268.352	296.006
July	61.365	62.625	63.091	64.110	282.102	288.690
August	63.875	63.523	65.260	64.431	293.690	29.319
September	66.535	.....	68.895	.....	306.273	.....
October	68.225	.....	70.245	.....	312.548	.....
November	68.667	.....	70.630	.....	309.284	.....
December	66.635	.....	68.514	.....	306.994	.....
Year	63.615	.....	65.285	.....	291.016	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

Zinc

	St. Louis		London			
	1926	1927	1926 Spot	1926 3 Mos.	1927 Spot	1927 3 Mos.
January	8.304	6.661	38.059	37.363	30.979	30.938
February	7.759	6.673	36.053	35.956	29.931	30.109
March	7.332	6.692	34.090	34.247	30.649	30.889
April	7.001	6.338	32.503	32.863	29.579	29.901
May	6.821	6.075	32.038	32.413	29.034	29.131
June	7.112	6.213	33.244	33.398	28.598	28.613
July	7.411	6.229	34.045	34.270	28.280	28.021
August	7.376	6.342	34.173	34.524	28.210	28.068
September	7.413	.....	34.389	34.415	.....	.....
October	7.296	.....	34.256	34.146	.....	.....
November	7.199	.....	33.491	33.483	.....	.....
December	7.018	.....	32.915	32.895	.....	.....
Year	7.337	.....	34.105	34.164	.....	.....

St. Louis quotations, cents per pound. London, pounds sterling per long ton

Antimony, Quicksilver and Platinum

	Antimony (a)		Quicksilver (b)		Platinum (c)			
					Refined		Crude	
	New York		New York		New York			
	1926	1927	1926	1927	1926	1927	1926	1927
Jan.	23.490	13.910	87.960	101.200	118.200	109.520	113.200	99.820
Feb.	21.676	14.509	87.580	101.727	113.909	107.545	108.341	99.295
March	19.708	12.801	88.194	110.259	112.000	108.000	106.278	100.426
April	17.462	14.166	89.769	123.250	111.538	101.885	103.731	91.865
May	12.170	12.975	91.365	123.900	108.960	84.680	102.900	75.000
June	11.106	12.447	91.346	118.096	111.000	72.000	106.615	62.500
July	14.490	11.880	90.163	119.880	114.692	72.000	109.000	61.520
Aug.	15.957	11.826	89.260	119.111	116.000	72.000	108.692	62.000
Sept.	15.325	.....	91.425	.....	116.840	.....	108.600	.....
Oct.	13.943	.....	97.260	.....	112.240	.....	106.000	.....
Nov.	13.385	.....	99.000	.....	112.000	.....	105.250	.....
Dec.	13.142	.....	99.510	.....	111.846	.....	105.385	.....
Year	15.988	.....	91.903	.....	113.269	.....	106.999	.....

(a) Antimony quotations in cents per pound, for ordinary brands. (b) Quicksilver in dollars per flask of 76 lb. Prior to June, 1927, the unit had been the 75 lb. flask. (c) Platinum in dollars per ounce.

Pig Iron, Pittsburgh

	Bessemer		Basic		No. 2 Foundry	
	1926	1927	1926	1927	1926	1927
January	22.76	21.04	21.76	20.01	22.26	20.26
February	22.76	20.76	21.76	19.76	22.26	20.26
March	22.76	21.15	21.76	20.33	22.26	20.26
April	21.38	21.26	20.66	20.49	21.05	20.26
May	21.12	20.94	19.76	19.96	20.76	20.26
June	20.76	20.66	19.76	19.62	19.80	20.11
July	20.44	20.26	19.26	19.26	19.49	19.76
August	19.87	.....	19.18	.....	19.26	.....
September	20.11	.....	19.26	.....	19.30	.....
October	20.76	.....	19.76	.....	19.97	.....
November	21.90	.....	20.46	.....	20.96	.....
December	21.26	.....	20.26	.....	20.53	.....
Year	21.31	.....	20.29	.....	20.64	.....

In dollars per long ton.

Monthly Crude Copper Output in Short Tons

Domestic

	1927					
	Feb.	March	April	May	June	July
Alaska shipments	2,696	3,163	2,121	3,045	2,105	2,798
Butte & Superior	.....	†416	.....	.....	†453	.....
Calumet & Arizona	1,500	2,704	1,711	2,422	2,075	1,866
Magma	1,120	1,308	1,232	1,270	1,250	1,066
Miami	2,160	2,342	2,295	2,346	2,176	2,233
New Cornelia	2,373	3,447	2,630	2,776	2,895	2,496
Nevada Con.	.....	†28,970	.....	.....	†27,821	.....
Old Dominion	1,162	986	879	1,030	815	825
Phelps Dodge	6,427	††7,789	8,063	7,972	8,085	7,706
United Verde Extension	1,152	1,322	1,630	2,051	1,768	1,868
Utah Copper	.....	†30,876	.....	.....	†30,028	.....
Tennessee Copper	408	458	410	433	390	408

Foreign

Boleo, Mexico	885	973	550	1,017	1,115	1,215
Braden	8,022	7,293	7,164	7 565	7,447	.....
Chile	9,352	9,352	9,352	9,791	.....	.....
Furukawa, Japan	1,249	1,638	1,416	1,493	1,569	.....
Granby Cons., Canada	1,975	2,339	2,123	2,989	2,287	2,261
Union Miniere, Africa	6,273	6,976	6,039	7,050	7,004	8,065
Mount Lyell, Aust	.....	† 1,347	.....	.....	1,42>	.....
Sumitomo, Japan	1,347	1,436	1,388	747	.....	.....
Bwana M'Kubwa	358	450	360	515	464	337
Andes Copper Mining Co.	.....	.....	.....	.....	2,495	.....

*Starting with December Allenby production is included. †Three months.
††Starting with March Moctezuma is included.

Monthly Production of Primary Copper from U. S. Mines and Daily Rate (Short Tons)

	1925		1926		1927	
	Monthly Production	Daily Rate	Monthly Production	Daily Rate	Monthly Production	Daily Rate
January	74,789	2,412	71,026	2,291	76,198	2,458
February	68,967	2,463	68,131	2,433	69,202	2,472
March	74,901	2,416	75,728	2,443	69,314	2,236
April	70,667	2,356	73,454	2,448	71,122	2371
May	70,574	2,276	73,542	2,372	71,613	2,310
June	59,894	2,330	71,317	2,377	69,539	2,318
July	68,507	2,210	72,278	,330	65,545	2,114
August	68,090	2,196	72,014	2,323	.....	.....
September	67,720	2,272	72,672	2,421	.....	.....
October	71,042	2,292	75,099	2,423	.....	.....
November	67,400	2,247	74,947	2,498	.....	.....
December	69,566	2,244	72,205	2,329	.....	.....
Total	842,117	.....	872,509	.....	492,533	.....
Monthly average	70,176	.....	72,709	.....	70,362	.....
Average of daily rate	.....	2,307	.....	2,390	.....	2,323

Mining Stocks—Week Ended Aug. 27, 1927

Stock	Exch.	High	Low	Last		Last Div.
COPPER						
Anaconda	New York	47¼	46	46⅞	Jy.16, Au.22 Q	0.75
Arcadian Consol.	Boston	*75	*75	*75		
Ariz. Com'l	Boston	7	5⅞	5⅞	Jy. 18, Jy. 30	0.25
Calaveras	N. Y. Curb			1⅛		
Calumet & Arizona	New York	72¾	70¼	72½	Se. 9, Se. 26 Q	1.50
Calumet & Hecla	Boston	16½	16	16⅛	Au. 31, Se.15 Q	0.50
Cerro de Pasco	New York	66½	63⅛	64⅛	Jy.14, Au.1 Q	1.00
Chile Copper	New York	36¼	36⅛	36⅛	Se. 2, Se. 30, Q	0.62½
Con. Coppermines	N. Y. Curb	3	2½	2⅝		
Copper Range	Boston	14¼	13¾	13⅞	Ap.2, My.2, A	1.00
Crystal Copper	BostonCurb	*46	*42	*43		
East Butte	Boston	1⅜	1⅛	1⅛	Dec., 1919	0.50
Granby Consol.	New York	41⅛	39	39⅛	Jn.15 Jy. 1 Q	1.00
Greene Cananea	New York	60⅞	55	56	Nov., 1920	0.50
Howe Sound	New York	41⅛	40	40	Jy.1, Jy.15, Q	1.00
Inspiration Consol.	New York	21⅛	19⅛	19⅛	Ma.17, Ap.4, Q	0.25
Iron Cap	Boston Curb	2	2	2		
Isle Royale	Boston	10⅜	10⅛	10⅛	Fe.4, Fe.19, Q	0.50
Kennecott	New York	72	68⅜	70⅜	Se. 2, Oc. 1, Q	1.25
Magma Copper	New York	38⅛	35⅞	36⅜	Jn.30, Jy.15, Q	0.75
Mason Valley	N. Y. Curb	89	80	80		
Miami Copper	New York	15⅜	14⅜	15	Au.1, Au.15 Q	0.37½
Mohawk	Boston	44½	42	43⅜	Jy.30, Se.1 Q	1.00
Mother Lode Coal	New York	2⅜	2⅛	2⅛	Jn.10, Jn.30	0.25
Nevada Consol.	New York	15⅞	14⅜	15⅛	Jn. 3, Jn. 7 Q	0.37½
New Cornelia	Boston	22⅛	21	21⅛	Au.5, Au.22 Q	0.50
Noranda	N. Y. Curb	24⅜	23⅜	24⅛		
North Butte	Boston	1⅜	1⅛	1⅛	Oct., 1918	0.25
Ohio Copper	N. Y. Curb	1 5/16	1⅛	1 1/16	Sept. 1926	0.03
Old Dominion	Boston	13¼	13	13	Dec., 1918	1.00
Phelps Dodge	N. Y. Curb			116	Jn.18, Jy.1 Q	1.50
Quincy	Boston	17	15½	15⅝	March, 1920	1.00
Ray Consolidated	New York			15	Ap.20, Ap. 30	0.25
St. Mary's Min. Ld.	Boston	21⅜	20	20	Fe.10, Ma.10	2.00
Seneca Copper	New York	1⅜	1⅛	1⅛		
Shattuck Denn	Boston Curb	5⅜	5	5⅛		
Tenn. C. & C.	New York	9⅜	8⅞	9⅛	Au.31,Se.15, Q	0.12½
United Verde Ex.	N. Y. Curb	24⅜	24⅛	24⅛	Jy.6, Au.1 Q	0.75
Utah Copper	New York	124	124	124	Jn. 17, Jn. 30 Q	1.50
Utah Metal & T.	Boston	1¼	1⅛	1⅛	Dec., 1917	0.30
Walker Mining	Salt Lake	*56	*55	*55		
NICKEL-COPPER						
Internat. Nickel	New York	68⅜	65⅜	66⅜	Jn. 16, Jn. 30 Q	0.50
Internat. Nickel pfd.	New York	108⅛	108¼	108⅛	Ap. 14, My. 2 Q	1.50
LEAD						
Gladstone Mtn	Spokane	*18	*14	*14¼	June, 1927	0.005
National Lead	New York	115½	113	113¼	Se. 16, Se. 30 Q	1.25
National Lead pfd	New York	110	110	110	Se.1, Se. 30 Q	1.75
St. Joseph Lead	New York	41⅜	40⅜	40⅜	Se.10,Se.20, QX	0.75
ZINC						
Am. Z. L. & S.	New York	7⅛	7	7	May, 1917	1.00
Am. Z. L. & S. pfd.	New York			40⅛	Nov., 1920	1.50
Butte C. & Z.	New York	4⅛	4	4	De. 9, De. 24	0.50
Butte & Superior	New York	9	8¼	8⅜	Jn. 17, Jn. 30 Q	0.50
Callahan Zn-Ld.	New York	1⅜	1⅛	1⅛	Dec., 1920	0.50
Consol. Lead&Zinc'A'	St. Louis	12⅛	12⅛	12⅛	Ma.15, Ap.1 Q	0.25
Eagle-Picher	Cincinnati	26⅜	26	26	Au.15, Se.1 Q	0.40
Eagle-Picher pfd.	Cincinnati	117½	117½	117½	Jn.30, Oc.15 Q	1.50
New Jersey Zn.	N. Y. Curb	189	185½	189	Jy.20, Au.10 QX	2.00
United Zinc	N. Y. Curb			*55		
Yellow Pine	Los Angeles	*36	*36	*36	Dec. 1925 Q	0.04
GOLD						
Alaska Juneau	New York	1⅜	1⅜	1⅜		
Argonaut	Toronto	*37	*35	*35½		
Barry-Hollinger	Toronto	*41	*38	*38½		
Con.W.Dome L.new.	Toronto	*9	*8	*8		
Cresson Consol. G.	N. Y. Curb	2¼	2¼	2¼	Ma.31,Ap.10 Q	0.10
Dome Mines	New York	9	7⅞	8¼	Jn. 30, Jy. 20 Q	0.25
Golden Cycle	Colo.Springs	†1.78	†1.75		Au.30, Se.10 Q	0.04
Hollinger Consol.	Toronto	17.99	17.25	17.30	Au. 24, Se. 9 F	0.10
Homestake Mining	New York	62½	61¾	61¾	Au.21, Au. 25 M	0.50
Kirkland Lake	Toronto	1.94	1.79	1.94		
Lake Shore	Toronto	24.75	22.50	24.40	Se.1, Se. 15 X	0.20
McIntyre-Porcupine	New York	25¾	25¼	25¾	Au.1, Se.1 Q	0.25
Portland	Colo.Springs	†*33	†*29		Ap.6, Ap.15, Q	0.02
Rand Mines	New York			45½	Au.22-29 Am.Sh.	1.52
Teck-Hughes	Toronto	9.30	9.05	9.20	Jy.21, Au.1	0.10
Tom Reed	Los Angeles	*30	*30	*30	Dec., 1926	0.02
Tough-Oakes	Toronto	*30	*25	*28		
United Eastern	N. Y. Curb	*35	*35	*35	July, 1924	0.05
Vipond Cons.	Toronto	*60	*58	*60	Apr.1, Apr.15	0.03
Wright-Hargreaves	Toronto	7.10	6.40	7.00	Jy.15, Au.1 SA	0.05
GOLD AND SILVER						
Carnegie Metals	Pittsburgh	14	13⅜	13⅜		
Con. Cortez	N. Y. Curb	*19	*18	*19		
Con. Virginia	San Francisco	*3½	*3⅛	*3⅛		
Dolores Esperanza	N. Y. Curb			*50	July, 1923	0.05
Premier Gold	N. Y. Curb	2⅜	2 3/16	2⅜	Jn. 14, Jy. 5	0.08
Tonopah Belmont	N. Y. Curb	1¾	1⅝	1⅞	Ma.15, Ap.4	0.08
Tonopah Extension	N. Y. Curb			*51	Apr. 1925	0.05
Tonopah Mining	N. Y. Curb	2	2	2	Ma.31, Apr.21	0.07½
West End Consol.	N. Y. Curb			*7	Mar., 1923	0.05
Yukon Gold	N. Y. Curb			*45	June, 1918	0.02
SILVER						
Beaver Consol.	Toronto	1.51	1.38	1.49	May, 1920	0.03
Castle-Trethewey	Toronto	*13¾	*12¾	*13		
Coniagas	Toronto	*75	*64	*73	May, 1924	0.12½
Keeley	Toronto	*92	*89½	*90	Se.1, Se.15	0.08
Lorrain Trout Lake	Toronto			*55	July, 1925	0.05
McKinley-Dar.-Sav.	Toronto	*15½	*15	*15	Oct., 1920	0.03
Mining Corp. Can.	Toronto	3.30	2.99	3.25	Jn. 29, Jy.15	0.12½
Nipissing	N. Y. Curb	5¾	5⅛	5⅜	Jn.30, Jy.20	0.07½

Stock	Exch.	High	Low	Last		Last Div
SILVER-LEAD						
Ahumada	New York	5⅛	4⅛	5⅛	Ma. 25,Ap.4,QX	0.12½
Bingham Mines	Boston	48	47½	47½	Jn.27, Jy. 5 Q	1.00
BunkerHill&Sullivan	N. Y. Curb	104⅜	102½	104	Jy. 30, Au.4 X	0.75
Cardiff M. & M.	Salt Lake	*44	*44	*44	Feb. 5, 1927	0.10
Chief Consol.	Salt Lake	2.62½	2.62½	2.62½	Nov., 1926 Q	0.10
Consti'nMng.&Mill'g	Spokane	*25	*20	*22		
Erupcion	Boston Curb	*75	*68	*70	Jn. 25, Jy. 5 Q	0.07½
Eureka Lily	Salt Lake	1.37½	1.07½	1.15		
Federal M. & S.	New York	1.52	1.46	1.46	Jn.25, Jn.29 Spec.	$10
Federal M. & S pfd.	New York	95¾	93	93	Au 25, Se 15 Q	1.75
Hecla Mining	N. Y. Curb	16½	16	16	Au. 15 Se 15 Q	0.25
Highland-Surprise	Spokane	*12½	*11	*11½		
Iron King Mining	Salt Lake	*51	*51	*51		
Keystone Mining	Salt Lake			*20	Au. 12, Au. 26	0.07½
Lucky Jim	Spokane	*20¼	*19	*20¼		
Lucky Tiger-Com.	Kansas City	†7.00	†6.75		Au.9, Au.20	0.05
Mammoth Mining	Salt Lake	1.90	1.75	1.90	Jn.10, Jn.20 Q	0.05
Marsh Mines	Spokane	*87½	*87½	*87½		
North Lily	Salt Lake	3.85	3.55	3.55		
Park Utah	New York	7¼	7¼	7¼	Jn. 25, Jy. 1 Q	0.20
Plutus Mining	Salt Lake	2.00	2.00	2.00	Jy. 10, Jy. 15 Q	0.10
San Rafael	San Francisco			*24		
Silver King Coal.	Salt Lake	9.00	8.80	8.80	Jn. 20, Jy. 1 Q	0.25
Silversmith	Spokane	*24	*22	*23	Oct., 1926 Q	0.02
Strattons Mines	Spokane	*49	*47	*48		
Sunshine M. Co.	Spokane	1.50	1.25	1.40		
Tamarack-Custer	Spokane	*25½	*23	*24	Sept., 1924	0.25
Tintic Standard	Salt Lake	13.50	13.00	13.00	Jn.15, Jn.28	0.40
Utah-Apex	Boston	5⅞	5	5	Oct., 1926	0.25
IRON						
Bethlehem Steel	New York	65	62⅜	63⅞	Se. 2, Oc. 1.	1.75
Cleveland-Clifis Iron	Cleveland	100	95	100	Jy. 15, Jy. 25 Q	1.00
Colorado Fuel & Iron	New York	80	75⅜	77⅜	May, 1921	0.75
Gt. North'n Iron Ore	New York	98⅞	96½	97½	Dec. 6, Dec. 28	0.75
Inland Steel	New York	53⅝	52	52	Au. 15, Se. 1 Q	0.62½
Replogle Steel	New York			12½		
Republic & S.	New York	69⅛	67½	68	Au 15, Se. 1 Q	1.00
Republic I. & S. pfd.	New York			105	Se. 15, Oc. 1 Q	1.75
Sloss-Sheffield S. & I.	New York	129¼	127	127	Jn. 10, Ju. 20 Q	1.50
Sloss-Shef. S.&I. pfd.	New York			107½	Jn. 20, Jy. 1 Q	1.75
U. S. Steel	New York	142	136⅛	141⅜	Au. 30, Se. 29 Q	1.75
U. S. Steel, pfd.	New York	135⅛	134⅛	135	Au.1, Au. 30 Q	1.75
Virginia I. C. & C.	New York			41	Jan., 1924	1.50
Virginia I.C.&C. pfd.	New York			60⅛	Ju. 15, Jy. 1	2.50
DIAMONDS, PLATINUM, ALUMINUM, VANADIUM, TIN						
De Beers Consol.	New York			27⅝	Jn. 26, Jn.30	1.45
So. Am. G. & P. New	N. Y. Curb	3	2⅜	3		
Alum. Co. of Amer.	N. Y. Curb	98⅜	97⅛	97⅛		
Alum. Co. of Amer. pf.	N. Y. Curb	104	104	104	Jn. 15, Jy 1 Q	1.50
Vanadium Corp.	New York	55⅞	52⅞	52⅞	Au. 1, Au. 15 Q	0.75
Patino M. & E.	New York	20⅛	20⅛	20⅛	Ap. 27, My. 5	1 sh.
ASBESTOS						
Asbestos Corp.	Montreal	31⅛	29	30	Jan., 1926	1.50
Asbestos Corp. pfd.	Montreal	95	93	93½	Jn.30, Jy.15 Q	1.75
SULPHUR						
Freeport, Texas	New York	75⅜	73½	74½	Jy. 15, Au.1 QX	1.25
Texas Gulf	New York	68½	65½	68	Ju. 1, Ju. 15 Q	1.00
MINING, SMELTING, REFINING AND GENERAL						
Amer. Metal	New York	44⅞	43⅛	43⅛	Au.20, Se.1 Q	0.75
Amer. Metal, pfd.	New York			110⅜	Au.22, Se.1 Q	1.75
Amer. Sm. & Ref.	New York	171½	167½	169	Jn 8, Au. 1 Q	2.00
Amer. Sm. & Ref. pfd.	New York	129	127	129	Au. 1, Se. 1 Q	1.75
Consol. M. & S.	Montreal	245½	231½	243	Jn. 30, Jy. 15 X	6.25
Newmont Mining	N. Y. Curb	96	92⅜	95½	Jn.30, Jy.15 Q	1.00
U. S. Sm. R. & M.	New York	43⅛	41⅛	41⅛	Jy. 6, Jy. 15 Q	0.87½
U.S. Sm. R.&M. pfd.	New York	50¼	50⅛	50⅛	Jy. 6, Jy. 15 Q	0.87½

* Cents per share. † Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. F, four weeks. I, Initial. X, Includes extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

Boston quotations courtesy Boston Stock Exchange; Toronto quotations those of the Standard Stock Exchange of Toronto, by courtesy of Arthur E. Moysey & Co.; Spokane, Pohlman Inve.tment Co.; Salt Lake, J. A. Hogle & Co.; Colorado Springs, Colo., Henry Sachs.

LONDON QUOTATIONS—WEEK ENDED AUGUST 16, 1927 Last Div.

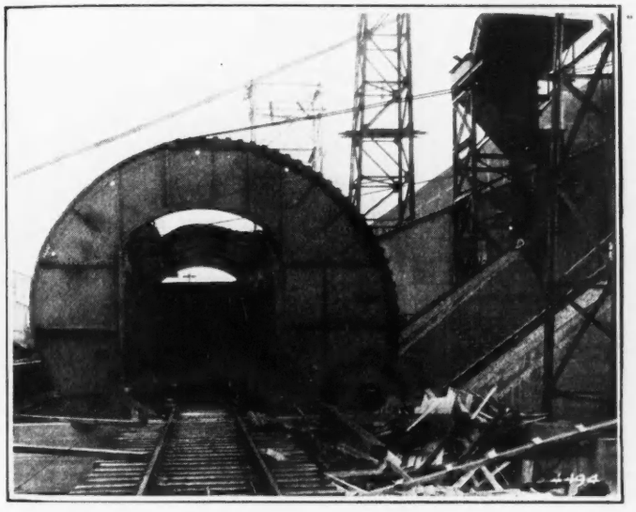
Name	High	Low	Last	Date	Amount
Aramayo Mines (25 frs.)	81/1½	76/3	76/3	Aug., 1927	5 p.c. (†)
British Platinum (£1)	2/—	1/1½	2/—	Feb., 1925	2½ p.c.
Burma Corpn. (10 rupees)	14/—	13/7½	13/9	Aug., 1927	6 annas*
Bwana M'Kubwa (5s)	4/10½	4/6	4/7½		
Camp Bird (2s)	4/4½	3/1½	3/3		
El Oro (£1)	3/6	3/3	3/4½	Nov., 1924	2½ p.c.*
Esperanza (10s)	—/3	—/1	—/1		
Frontino & Bolivia (£1)	15/—	14/7½	15/—	July, 1927	5 p.c.
Mexican Corpn. (£1)	8/3	7/—	8/—		
Mexico Mines of El Oro (£1)	16/3	15/3	16/3	Dec., 1926	3¾ p.c.*
N'Changa Copper Mining	9/6	9/—	9/6		
Oroville Dredging (£1)	5/—	4/1½	5/—	Dec., 1923	⅜ p.c.
Ouro Preto (£1)	2/6	2/—	2/6	May, 1925	2½ p.c.
Rhodesian Congo Border (£1)	41/3	35/—	40/—		
St. John del Rey (£1)	10/9	10/6	10/9	May, 1927	3½ p.c.
San Francisco Mines (10s)	28/7½	27/10½	28/3	July, 1927	15s.
Santa Gertrudis (£1)	16/9	15/—	15/6	July, 1927	7½ p.c.
Selukwe (2s. 6d.)	8/10½	8/1½	8/3	April, 1917	6¼ p.c.
S. Amer. Copper (2s.)	3/—	2/9	2/9	Nov., 1917	75 p.c.
Tanganyika (£1)	70/3	53/9	55/—	Aug., 1926	7½ p.c.
Union Miniere du Haut-Katanga (Brussels)	10.090	9.650	9.900	July, 1927	182.60 (†)

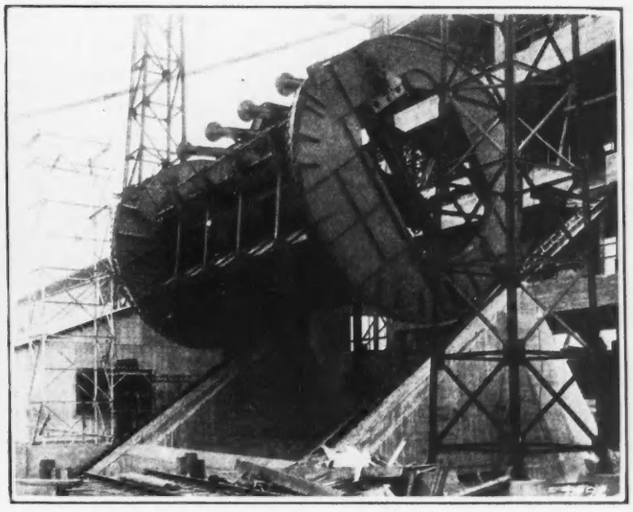
* Free of British income tax. † Swiss francs and plus 15 p. c. bonus. ‡ Belgian frs. and free of taxation.

Modern Equipment

A Unique Car-Dumper Installation

AT THE new plant of the Florida Portland Cement Co., Tampa, Fla., there has been installed for the handling of cement rock from railroad cars to the storage yard at the crusher plant, a Wellman car dumper having a number of unique features. In the accompanying photographs the view at the left shows the dumper in normal position to receive a car and to the right of the dumper the inclined runways upon which the dumper is rolled into the dumping position. The view at the right shows the dumper in dumping position at the top of the incline.





Left—The car dumper in its initial position at rail level and about to roll up the inclined runway to the right to dump the car that is on it. Right—The dumper in dumping position on the runway

Peculiar conditions surrounding this installation required an equipment which would unload the cars without providing the usual storage bins under the dumper. The general level of the ground is only a few feet above water level, and it was desired to provide storage for a day's consumption at the crusher plant without rehandling. By rolling the dumper up an incline the bin was not necessary, and sufficient storage was provided to meet the requirements.

As will be observed, this dumper, though similar in many respects to the well-known Wellman revolving car dumper, instead of being "revolved" upon the equalizing rollers carried in structural steel bases secured to the foundation, is "rolled" into its dumping position upon steel girder runways which are inclined at approximately 35 deg. The machinery for "rolling" the dumper up the incline is mounted on foundations at the ground level under the crusher tower. It consists of two drums spaced 50 ft. center to center, each being driven by a double reduction of cut gearing, the second intermediate shaft being extended the full distance between the drums and geared at the center to the driving motor, and provided with a manually operated brake used only in an emergency. The service brake is electrically operated and attached directly to the motor.

The platen is supported on forged steel flat tread rollers, which run on flat plate paths riveted to the cross frame of the tipple.

In the installation described the car clamps are of the pivoted counterweight type, four clamps being provided for holding the cars in position while dumping and during the return cycle of the dumper. Each clamp has its own independent operating mechanism. As all the clamp mechanism is carried at the rear side of the dumper, dumping is unobstructed except for the narrow clamp beams themselves.

When the dumper is in position at the start of the dumping cycle, the counterweight rollers rest upon the inclined guides, the chain is nearly unwound from the chain wheel, the clamp counterweight ropes are nearly unwound from the holding rope drum, and the lifting rope is wound upon the clamp-lifting drum. As the dumper begins to rotate in the dumping direction, the counterweight rollers will move up the inclined guides, which will slacken the chain and allow the clamp lifting ropes to pay off the lifting drum so that the slides and beams will lower, because of their weight, until they rest upon the top of the car. During this part of the operation the clamp counterweight, or holding ropes, are wound in the same amount as the lifting ropes are unwound. When the slides and beams rest upon the top of the car, rotation of the drum ceases. After the counterweight has left the inclined guides, the counterweight arm hangs vertical until the pawl is thrown into engagement, which occurs after the cradle has rotated about 45 deg. During the rest of the dumping cycle the counterweights act as a fixed arm in reference to the drum center, but the actual, or gravity, arm constantly increases until the car is dumped. This arrangement produces the greatest holding force upon the car at that part of the cycle when the car and its contents have the greatest tendency to leave the platen.

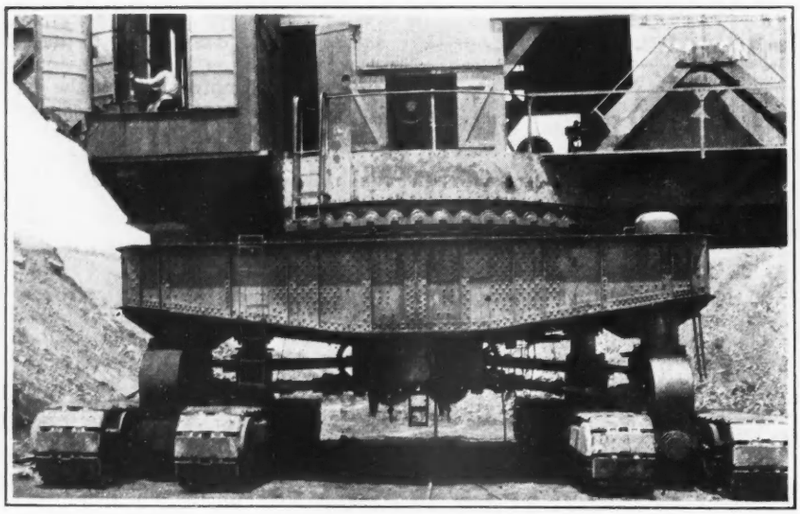
The pawl is brought into engagement with the ratchet wheel on the holding drum by means of a roller. It has an extension with the roller at its end, and when the dumper has revolved about 45 deg., this roller strikes a cam pivotally fastened to the dumper frame and forces the pawl to engage the ratchet on the holding drum and compress the pawl holding-out spring.

After the contents of the car have been discharged, reverse rotation of the dumper will reverse all operations, and the slide and beam will be raised to their original position by the pull of the chain caused by the counterweights rolling down the inclined guides. This will revolve the chain wheel in the proper direction to wind up the lifting ropes.

This dumper is driven by one 115-hp. motor provided with a full torque magnetic brake, and a controller of the magnetic switch type. The machine is fitted with a geared limit switch to slow down and stop the rolling of the dumper in either direction.

The dumper will handle open-top railway cars from 7 ft. to 12 ft. 6 in. high; 9 ft. to 10 ft. 6 in. wide and over-all lengths of 50 ft. inside of cars, and having a loaded weight of car and contents of 220,000 lb.—that is, cars with 80 tons' capacity of rock, plus approximately 10 per cent overload and a tare weight of 45,000 lb., at the rate of 20 cars per hour.

The Cowham Engineering Co., of Chicago, were the consulting engineers in the building of this plant, the dumper being designed and constructed by the Wellman-Seaver-Morgan Co. of Cleveland.



The construction of the under frame of this caterpillar-mounted shovel is typical of the machine described in the accompanying article

Largest Stripping Shovel Has Tractor Mounting

A COAL company is to put in operation on its property near Verona, Ill., an electric stripping shovel that the makers claim is the largest ever built. The shovel is of Marion make (Type 5480). It is to be mounted on crawling traction trucks equipped with hydraulic equalizing jacks which automatically hold the machine perfectly level while traveling or working on rough or uneven ground surfaces. It carries a 90-ft. boom, a 60-ft. dipper handle, and a 12-cu.yd. dipper, and it is expected to strip overburden up to approximately 50 ft. in depth.

Although much heavier throughout, the design of the Type 5480 machine follows closely that of the company's Type 350, which is so widely used in coal stripping and in the mining of various ores.

The electrical equipment is manufactured by the General Electric Co. and consists of two 255-hp. motors on the hoist, two 75-hp. motors on the swing, and one 150-hp. motor on the crowd, all motors being rated on a 60-minute basis. The motor-generator set which furnishes power to the individual motors has a continuous rating of 700 kva.

In range the machine is approximately the same as that of the Type 350, and, with the increased dipper capacity, is designed to establish a new record of 50 per cent more production than was possible heretofore. The shovel will be used by the Northern Illinois Coal Corporation, of Verona, Ill.

New Push-Button Station Keeps Motors Running

TO PREVENT the cutting out of motors controlled by a magnetic starter when there is a brief power disturbance, a new push-button station has been introduced by General Electric. The station has two push buttons, marked "Start" and "Stop" respectively. It is used with standard magnetic starters, making it unnecessary to add time-delay attachments to the starters themselves. When power fails, the magnetic starter will drop out, but will be caused to reclose upon the return of voltage by the push-button device, provided the time for which the push-button station is set is not exceeded. If the time is exceeded the "Start" button must be pushed to energize the magnetic starter and so restart the motor.

In operation, pressing the "Start" button of the push-button station closes the pilot circuit of the magnetic starter and also the circuit of a coil in the push-button station. This coil is part of a "lift" solenoid, and when energized causes the solenoid plunger to rise. At the bottom of the plunger are spring-attached contacts which are closed by the lifting action, thus maintaining the circuit through the solenoid itself and also the pilot circuit of the magnetic starter with which the device is used.

When the voltage drops sufficiently to permit the solenoid to release the plunger, the latter starts to fall, but is retarded in its downward movement by a rack which turns a gear. The gear engages a ratchet which can be adjusted for a maximum of 1½ seconds by means of a heavy nut at the end of the rod which serves as a pendulum. If power does not return before the time expires for which the device is set, then the contacts will be opened and both the solenoid and the magnetic starter will be disconnected until the "Start" button is again pushed.

Pressing the "Stop" button stops the motor at once, because this action immediately opens the pilot circuit of the magnetic starter and likewise disengages the rack of the solenoid plunger so that the latter falls instantly. The station is known as CR-2940-BS-82-A.

CATALOGS

PUMPS—Bulletin 98, Krogh Pump & Machinery Co., San Francisco. A full-lined sand and tailings pump. Pages 8, illustrated.

FURNACE — Bulletin 200, covering Nichols Herreshoff furnace for roasting, calcining and drying. Manufactured and distributed by Nichols Copper Co., New York City; Pacific Foundry Co., San Francisco. Pages 32, illustrated.

GAS MASK—Bulletin issued by Mines Safety Appliance Co., Braddock Ave. and Thomas Boulevard, Pittsburgh, Pa., covering the Burrell all-service gas mask.

WELDING—The Linde Air Products Co., 30 E. 42d St., New York City, has issued a 70-page bulletin containing a report on the design, development, fabrication, and testing of a series of oxy-acetylene welded roof trusses of the Fink type.

ORE DRESSING—Bulletin No. 13, W. W. Gibson, 112 Market St., San Francisco, covering counter-balance rod mills, concentrators, oil flotation cells, gyratory mills, rock breakers, amalgamators, ore feeders, and elliptic rock crushers. Pages 30, illustrated.

FLOTATION—Bulletin F23, Ruth Company, First National Bank Building, Denver. The Ruth concurrent flotation machine. Pages 20, illustrated.

DUST COLLECTING — Bulletin 1028, American Blower Co., Detroit, Mich. Entitled "Collecting Fly-Ash and Coal Dust." Pages 12, illustrated.

THICKENER — Bulletin 140, United Filters Corporation, Hazleton, Pa. The design and operation of the Sweetland thickener. Pages 20, illustrated.

HEAT-TREATMENT — Bulletin 16, Lebanon Steel Foundry, Lebanon, Pa. The heat treatment of electric furnace steel castings.

SPEED CHANGER—Bulletin 156, Stephens-Adamson Manufacturing Co., Aurora, Ill. A new speed changer of variable speed. Pages 24, illustrated.

FLOODLIGHTING—Crouse Hinds Co., Syracuse, N. Y. Folder No. 44. Greater efficiency in floodlighting.

CONCENTRATING TABLE—The Deister Concentrator Co., Fort Wayne, Ind. Bulletin 18-A covering the No. 6 Deister-Overstrom diagonal deck sand or slime table. Pages 4, illustrated.

DUMP CARS—Coeur d'Alene Hardware & Foundry Co., Wallace, Idaho. Bulletin No. 72. Coeur d'Alene dump cars for mine and industrial use. Pages 20, illustrated.

WATER TANKS—1927 catalog of W. E. Caldwell Co., of Louisville, Ky. Tanks and towers of wood and steel. Pages 50, illustrated.

WHEELBARROWS—Folder No. 205 of the Akron Barrow Co., Akron, Ohio, announces that on Sept. 1, 1927, the company changed its name to the General Wheelbarrow Co.

SWITCHES—The Allen-Bradley Co., of Milwaukee, Wis., manufacturers of electric controlling apparatus, have issued several bulletins of the loose-leaf type and covering their products.